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A Duty That is Opposed to American Machinery Interests.

Those citizens who believe in the sentiment that pervaded the Detroit convention of the National Association of Manufacturers and in the declaration of principles laid down by our late President in his last public address, and especially those who would do something to forward these ideas and to better the conditions of our foreign trade would do well to store up in their memories some of the things that have been said by Mr. Schwab, the president of the United States Steel Corporation, who seems to consider it not inadvisable to talk at times in ways that are very enlightening to outsiders who may be willing to devote a little thought to what he says.

By cable reports have been received of an address made by Joseph Lawrence, M. P., before the Newport Chamber of Commerce, in which address Mr. Lawrence told his audience that Charles M. Schwab assured him that the Steel Trust could deliver steel billets in England for $16.50 a ton, whereas the lowest price for which British manufacturers could make them was $19. Mr. Schwab, he said, also asserted that, when the Trust had completed certain ocean transportation arrangements now pending, the American price would be still lower. In addition to this statement, Mr. Schwab called the attention of Mr. Lawrence to the fact that his (Mr. Schwab's) steel workers got double the wages paid British workmen in the same line.

The prices for steel billets at Pittsburgh are about $26 to $27 per ton, which means that American machinery builders and others who use American steel out of which they make machinery, much of which they must sell abroad if at all, pay at least $10 per ton more than Mr. Schwab himself declares the steel can be delivered for in Great Britain, where it may be used by machinery builders competing in British and Continental markets with our American machinery builders who export to these markets. In the face of such indubitable evidence that we produce steel here cheaper than it can be produced in England, what possible excuse is there for maintaining an import duty under the operation of which American steel users are made to pay much more than their British competitors? Does it not seem as though here is one of the duties that President McKinley had in mind when he spoke of the possibilities of our having duties that are no longer needed?

The Relative Hardness of American and European Cast Iron.

It is quite generally believed, not only in Europe, but here as well, that the British and Continental cast iron is generally very much harder to work than that which is found in American machine shops. We do not know just how much truth there may have been in this in the past, nor how much there may be in it now, but it is at least interesting to know the experience of a young man who has had considerable shop experience in America and has been abroad the past two years introducing and demonstrating the workings of a certain well-known American machine tool that works cast iron principally. He declares that all over Europe he has worked cast iron and has found it to be not a whit more difficult to work than that which he has worked in America; that the machine works it just about the same as it is accustomed to work American cast iron, with about the same kind of tools, ground and handled in the same way.

This leads us to think that perhaps the belief that European cast iron is harder than that to be found here is based upon facts which have perhaps ceased to exist and it might be well for those who still think that our American cast iron is necessarily and always softer than other irons to investigate the matter a little and find out whether it is really so or not.

Official Records of the Navy.

There is a general impression that whatever is "official" is beyond question, and "official" reports of various kinds are quite commonly regarded with something like veneration and awe, notwithstanding that fallibility has been shown to be one of their attributes in common with most human work. But especially have we all felt constrained to accept without question official reports made by naval officers, and yet it is being shown by the court proceedings at Washington that even these may err. Not only may they err, but also it seems the men (and they are mere men, after all) that make them may know that they err. Commenting upon the matter, the New York "Times" aptly remarks:

"What does 'official' mean, anyhow? Hitherto a confiding public has ascribed to the word a significance little less than that of 'authentic' or 'unquestionable,' but so ready have been the—well, the prosecuting attorneys in the Schley inquiry to admit both the incompleteness and the inaccuracy of the logs, charts, reports, etc., made by naval officers in the regular course of duty, that, for the moment at least, the civilian mind is filled with an amazed, not to say an angry, distrust of everything 'official.' The chart of maneuvers in a great battle, for instance, is coolly tossed aside as 'worthless' by the very men who made it, the position taken by them, apparently, being that though the chart is good enough to file away in the national archives for the amusement of the student and historian, it is not good enough to refute, or even to confuse, its makers when the difference between its testimony and theirs is called to their attention! The official chart, it seems, is merely a rough-and-ready compromise between widely varying guesses. To have sifted the evidence and to have reached and recorded the facts of the case would have taken too much time and been too much trouble. The Navy Department, we read, never had an opportunity to admit all this before, else would it gladly have done so! That may be true—it must be true, since it is the statement of men who, as an officer of high rank said the other day, have a regard so profound for honor and professional obligations that civilians

simply cannot understand how absurd it is to apply to them the tests and restrictions imposed on ordinary humanity. There will be no present hesitation to confess this inability frankly and promptly. When a civilian makes a record or a map, if he is honest he does it with accuracy if he can, and if he cannot he says so. Naval officers, according to these latest revelations, are different, and their logs and charts, though 'official,' are 'worthless' as evidence in courts—of inquiry and others. 'Tis passing queer!"

Another queer thing was brought out by the testimony of one of the men who was in a responsible position in the engine-room of the "Texas" during the engagement off Santiago. He testified that for a time during the chase after the Spanish ships the engines of the "Texas" were reversed. Now we all know that the reversal of the engines of a naval vessel while going at full speed is significant of something, and that if an engine-room log is being kept, it may fairly be expected to show that such a reversal took place in obedience to signals from the bridge. When the witness had his attention called to the fact that the log was silent on this point, he said not everything got into the log; but when it was further shown that the handling of ashes in the regular course of events was recorded in the same log, there was no explanation that seems at all satisfactory as to why the log maker recorded the utterly insignificant moving of ashes, but not the reversal of the engines, one of the most important things done in the engine rooms.

Good Men in Charge of Exhibits.

At Buffalo we see once more the phenomenon of good and expensive exhibits of machinery in charge of persons utterly incompetent to help interested visitors to understand it or to interest them in any way. If we did not see the thing done over and over again it would be almost unbelievable that builders of good machinery and generally competent business men would go to the expense of placing and maintaining an exhibit and then putting it in charge of a man who actually detracts from and injures the exhibit rather than helps it.

Some things are done thoughtlessly by attendants who apparently overlook the purpose for which a machine is exhibited. Many people know about how an automatic machine of any kind ought to work where the custom is to have one man look after from two to a dozen of them. Most any machinery man knows of course that such machines must go on with their work without attention for periods varying with the nature of the job they are employed upon, and if they will not do that they cannot be said to be automatic; yet such machines are seen in exhibitions being operated by men who act as though it was necessary to stand over them every moment of the time, stop them every few seconds to rub a tool with an oil-stone or gaze at something as though trying to find out what is the matter with it. Now it seems to us that the way to show an automatic machine at work is to let it work and go off and sit down and read a paper or talk with a visitor, and really act as though it was expected that the machine would work and that nothing would happen to wreck it if it were left alone for a minute. The impression that is gotten by some visitors to expositions is that an automatic machine requires rather more concentrated attention by the operator and more "fussing with" than a plain machine does that is not automatic.

Another "Useful" Patent.

The following is the interesting specification of a recent United States patent for a "method of welding metals":

"In carrying out this invention a fire is made of any approved fuel on a blacksmith's hearth the usual way, and the metals are prepared for welding in any approved manner. Sulphur is sprinkled into the fire before the metals are placed in the fire for the purpose of being brought to the welding heat. Common sulphur or brimstone is used, and it is preferably used in the form of powder. The sulphur is added to the fire and is stirred into it if necessary. Its action appears to be to clean the fire or the metals, or both of them, of something, such as impurities, which usually makes welding difficult. A heaping tablespoonful of sulphur will usually suffice for one welding operation. The sulphur is not applied to or placed on the metals, as the direct application of sulphur to the metals will not effect the desired result, the beneficial effect of the sulphur being obtained by treating the fire with it before placing the metals in the fire. By first treating the fire with sulphur before bringing the metals to the welding heat copper, brass and other metals can be welded as well as iron and steel. When steel is welded, borax can be used as a flux in the ordinary way, and the use of sulphur in the fire does not necessitate a change of the other steps of the ordinary method of welding metals as performed by blacksmiths."

It may or it may not help the welding operation, but it cannot fail to impair the quality of the iron or steel that is victimized by it. We have not heard lately of the once familiar trick of the blacksmith of cutting a bar of hot iron in two with a stick of sulphur. Heat the bar to a bright red, take it out of the fire, lay the stick of sulphur on it and the iron will flow like water and the end of the bar will drop off. The two parts of the bar while in this fluid condition could of course be reunited and easily welded, but it would be found that the metal was worthless near the weld for any purpose.

The very scientific account of the action of the sulphur in the fire, as approved by the examiners of the Patent Office in the specification, is commended to the attention of those who appreciate that kind of science.

The "Kronprinz Wilhelm."

About a hundred newspaper men were entertained at a dinner given on board the new German steamship "Kronprinz Wilhelm" the evening of the 27th ult., and had unusual opportunities for inspecting every part of this, the newest, probably the fastest and certainly the most magnificently furnished and appointed steamer on the Atlantic. The "Kronprinz" is designed especially to attract first-class passenger traffic and seems well adapted to that end. While on her maiden trip she encountered very severe weather, some of the destructive effects of which were to be seen and which delayed her somewhat, she made one day's run that averaged a higher speed than any other vessel has made on her first voyage—22 knots an hour—and it is confidently expected that she will prove the fastest passenger steamer afloat. She was built by the Vulcan Iron Works at Stettin, has twin screws, driven by quadruple expansion engines, each with two high, first and second intermediates and two low-pressure cylinders. These are arranged on four cranks—the high-pressure cylinders on top of the intermediates and the low-pressures at either side of the four central ones. Steam is supplied at 225 pounds pressure and the horse-power developed is about 33,000. The vessel is the latest addition to the fleet of the North German Lloyd Company, which is building a steamer which is expected to surpass this one.

The Swiss Machinery Industry.

This industry reached in 1900 a degree of production hitherto unknown. The exports attained a figure sensibly above that of 1899 and almost double that of 1895. The exportation of machines, machine parts and iron constructions covered by the statistics of the Committee of the Swiss Machinery Industry was as follows:

1891	20,430,000	francs
1892	20,270,000	"
1893	23,710,000	"
1894	25,670,000	"
1895	24,950,000	"
1896	29,290,000	"
1897	23,250,000	"
1898	37,270,000	"
1899	44,020,000	"
1900	48,210,000	"

The growth has therefore been particularly during the last five years. It may be added that the imports also have increased from 20,700,000 francs in 1895 to 30,300,000 francs in 1900.

All branches have not been benefited equally in the increase of exports. In the

first rank come dynamo-electric machines (3,630,000 francs in 1895 against 12,690,000 francs in 1900). Milling machinery has passed from 3,300,000 francs to 3,900,000 francs; looms and weaving machinery from 3,900,000 francs to 5,890,000 francs. The products included in the class "other machinery of all sorts" have practically doubled, amounting to 16,220,000 francs in 1900 as compared with 8,600,000 in 1895.

These figures alone, however, do not accurately represent the present situation, nor the future. The year 1899 had clearly demonstrated the considerable share that Switzerland has taken in general economic development. The importation of coal had increased by 8 per cent. and that of pig iron by 25 per cent. In 1900 the latter remained practically the same, while the importation of coal showed an increase equal to that of the former year. This increase may be attributed to commercial and household needs. A better thermometer of industrial activity is formed by imports of "machine parts in the rough." It may be remarked that the amount of this class increases proportionately to the production of Swiss works and also that when these are very busy it is further augmented from the fact that they have to look to outside assistance for a sort of work for which under normal conditions they would prefer to depend upon their own shops. The two divisions under which rough machine parts are placed amounted together to 6,904,925 francs in 1900 against 7,797,330 francs in 1899, showing a falling off of about 12 per cent. This materially lessens the satisfaction felt in considering the year's results. Moreover, the number of workmen employed in the shops of members of the association shows a decrease. January 1, 1900, it was 26,258, and by December 31 it had dropped to 25,286. Thus, while the falling off was not so sharp as in some other countries, such as Germany, it showed that the increase of the past few years had given place to a stationary condition.

The situation therefore is as follows: In 1900 exports increased, although relatively less than in 1899. On the other hand the number of workmen has decreased a little and the imports of rough machine parts quite sensibly. The following conclusion may be drawn: The Swiss domestic consumption of products entering into the manufacture of machinery has fallen off, which is confirmed by the diminution of 11 per cent. in the value of machines imported. So Switzerland has bought in 1900 sensibly less machinery than in 1899. The increased exports of Swiss machinery taken in conjunction with this are attributable in great part to the fact that during the first half of the year 1900 industry abroad, especially in Germany, was overloaded with work and unable to accept orders.

As is well known, the necessity of the Swiss machinery industry to draw upon foreign countries not only for its raw materials but for finished materials and also accessory products, has called for great effort on the part of the manufacturers to attain their present position. It may readily be believed, therefore, that they regard the future with apprehension. A great electrical house, according to the report, echoes the sentiment thus: "In the long run, shall we indeed be able to sell abroad, or will not our foreign markets learn to supply their needs, at least in part? This is what one asks in contemplating the obstacles met by our industry in being compelled to look abroad for raw materials and also in our tariff and the general situation in which our political and social organization has placed our factory. These difficulties are already keenly felt, particularly for the larger products. We have reference to the legislation and financial politics of certain cantons which attach little importance to industrial necessities, in contrast to many other countries which place these matters on the highest plane."

Some large houses have already, as is known, begun to establish branches abroad. This movement has not yet displaced the parent houses in Switzerland as the chief center of business. It is necessary, however, that the Swiss works prosper and continue to be in a situation to assure by their progress a governing place among the various branches that they have founded for the construction of machinery. From this point of view one must regard the renewal of commercial treaties. The Swiss machinery industry demands absolute reciprocity for all products that can be manufactured in the country on an equal basis and of at least equal quality. And where foreign duties are disproportionately higher than the Swiss tariff, the machinery industry demands for manufactured articles which we are in a position to deliver at home that they be protected against foreign competition by means of duties establishing a parity, so that the foreigners cannot import into Switzerland under more favorable conditions than the Swiss products may be exported. This equalization is necessary by reason of the greater cheapness of raw materials and of coal as well as more favorable conditions of transportation which foreign competition possesses. With the cessation—already entered upon—of the period of exceptional activity in the machinery industry abroad, foreign competition in Switzerland will be still more active.—Translated from the "Moniteur Industriel," Paris.

War vs. Tunnels.

Those who still think that society as a whole gains by wars or by preparation for wars may well reflect upon the words of Lord Roseberry, who, speaking at Stranraer, Scotland, commented upon the possibility and desirability of a tunnel between Scotland and Ireland, and said he believed the £8,000,000 that it would cost would be well spent. "Anyhow," he said, "the amount spent in this way would not equal the cost in two months of the melancholy war still dragging on in South Africa, and if by any means that war could be shortened by two months there would be money for the tunnel."

Commercial Review.

NEW YORK, Monday, Sept. 30.

MACHINERY AND SUPPLY MARKET.

Those who remember the aspect of trade a year ago and the indications which then were visible, that the tool business was on a sharp down grade, may well feel satisfied at the fall conditions of 1901. Our machine-tool factories have safely survived the loss of European exports and have found domestic trade with the little foreign that remains ample to fill them up with work. One shop is heard of which has orders on hand for six months ahead and there may be others in a like situation. There is a particularly active demand for lathes and planers.

Machinists' supplies have experienced an expansion of sales with the return of cool weather, but not a very great one for the good and sufficient reason that August had filled out so well as to leave little room for further growth.

The situation in a most favorable aspect is presented by a certain supply concern which, unlike some others, has experienced a decided change with the month of September. The business of this house had fallen off by a half or two-thirds in the summer, but it has recovered its old footing. Its men in all parts of this district—New York and Brooklyn, up State, Jersey and Connecticut—agree in reporting an active demand, with signs that their customers are increasing shop operations. Such a sign is the call for calipers, gages and other tools which machinists buy for themselves as distinguished from staples, such as drills and files, which the shop proprietors purchase. The machine shops are manifestly taking on new men. When they do so they frequently notify their dealer to send around and get orders for the equipments the men will need. The machinist has too often parted with his tools since his last job, and to save his borrowing and to put him in a position for efficient work the company will advance something toward his outfit.

Another source of demand for this class of tools which will open up very shortly is that from the technical schools. Everyone who has attended a technical school will pronounce this a most certain line of business, since the student buys not what he is in the humor or the cash for, but what he is told to, loading himself down with instruments, some of which he may not use half a dozen times in his college course, even if he has not lost them before the time comes to find out what they are good for.

One of the most noteworthy items of information in the machine-tool industry is a report that C. M. Conradson and others of Wilmington, Del., are interested in the establishment of a plant for the manufacture of turret lathes and perhaps a full line of machine tools. The Board of Trade of Wheeling, W. Va., is negotiating to get this establishment for that city. The works would cost about $250,000 and have about 75,000 square feet of floor space.

At the annual meeting of the Whitman & Barnes Mfg. Co., manufacturers of twist drills, etc., a decidedly successful year was reported. The company has lately brought out a new line of air drill reamers.

It is stated by parties in interest that the constituent companies of the International Steam Pump Company have more work on hand than they can handle. It is also asserted that in July the orders amounted to $1,550,000, as against $541,000 for the corresponding month in 1900. For four months ended July 31 orders are said to have aggregated $3,056,000, as against $2,571,000 in the same period a year ago.

The stockholders of the Société industrielle d'électricté (procédés Westinghouse) have voted to form a new French company with a capital of 20,000,000 francs for the exploitation in France, Belgium, Switzerland, Spain and Portugal and their dependencies, of the various patents and rights of George Westinghouse, including those on brakes. This new company succeeds to the Société Industrielle.

An order of the War Department was promulgated, September 27, making a reduction of 50 per cent. in the duty on all machinery for making sugar and brandy, and for agricultural purposes, imported into Cuba during the twelve months beginning October 1. A special provision is also ordered allowing the entry of railroad material at 5 per cent. ad valorem when imported direct by a steam or street railroad company of Cuba. In admitting agricultural machinery at a 50 per cent. rebate of the 10 per cent. ad valorem duty the order provides that the machines must be complete and must be imported in one sole shipment. It is stated at the War Department that there will be no other change in the Cuban tariff, and the Secretary of War will not approve the report made by the special board which convened in Cuba to revise the Cuban tariff.

The Cuban demand for machinery and supplies from the United States is not a very heavy matter, however, and it is unlikely to become so until the political future of the island looks more secure than at present. But what is the loss of Cuba is the profit of Spain, for both capital and personal talent and energy have been withdrawing to the home country. In the days when Cuba was regarded in Spain as an El Dorado the old country was drained of its enterprise by the lucrative island. The turning of attention to domestic affairs has given impetus to the development of Spain, in which the industrial experience gained in Cuba, including the broadening influence of contact with the United States and other progressive nations, has probably contributed its share.

CHICAGO MACHINERY MARKET.

The Western trade for machine tools this month is about as satisfactory as it could well be and remain within reasonable bounds. All sellers are doing a brisk business. There are indirect intimations that just now business is relatively better in the Chicago districts than in some other parts of the country, and one explanation for this is that when quiet first appears it is localized and gradually spreads thence over the country. There is, however, some special reason for activity in the West in the creation here of many new companies for the manufacture of iron and steel products. One branch of industry that seems especially brisk just now is the manufacture of gas engines. A number of plants are springing up in the West and they are calling for shop equipments. There is perhaps less development of that sort at Chicago proper than throughout Illinois and in the adjoining States of Wisconsin, Iowa, etc., but the equipments of these plants are usually included in the Chicago trade. This new business, however, does not wholly nor largely explain the current trade. There is a large pick-up business of one or two machines each and also many additions are being made to existing plant equipments. In fact, the latter portion of the trade, the purchases made by old manufacturers, is said by some dealers to constitute their principal business this month.

September trade in machine tools follows a month of unusual activity, for August was one of the best months in years. September, however, will probably surpass it in volume in this territory. There has been lately an especially good demand for planers, and it is stated that one of the largest producers in Cincinnati who not long ago was making two months delivery on any of his products is now asking four months for the larger planers. But generally there is not a marked scarcity of machines.

It has been one of the recent features of trade that orders have been pretty well split up among sellers. There are large inquiries still in the market, the placing of which has been hanging fire for a number of weeks. J. B. Doan & Co. have sold a complete machine-shop equipment to the Illinois Steel Company, Joliet, Ill., and one to the Algoma Central Railroad Company, Sault Ste. Marie, Ont., for a car and locomotive repair shop. McDowell, Stocker & Co. have sold a shop equipment to the Burlington & Northern Railroad Company for installation at Sheridan, Wyo. The Marshall & Huschart Machinery Company report business exceedingly satisfactory.

Quotations.

NEW YORK, Monday, Sept. 30.

Pennsylvania Foundry Pig Irons, Jersey City delivery:

No. 1 X	$15 15 @ $15 65
No. 2 X	14 65 @ 15 15
No. 2 plain	14 15 @ 14 65
Gray forge	13 50 @ 14 00

Alabama Pig, New York delivery:

No. 1 foundry, or soft	15 50 @ 15 75
No. 2 foundry, or soft	14 75 @ 15 00
No. 3 foundry	14 25 @ 14 50
Foundry forge, or No. 4	13 75 @ 14 00

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.68c. in carload lots; from store, 1.90 @ 1.95c. in small lots.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—1.90 @ 2.00c. from store.

Cold Rolled Steel Shafting—Base sizes—From store, 2½ @ 2¾c.

Copper—Lake Superior ingot, 16⅝ @ 17c.; electrolytic, 16⅜ @ 16⅝c.; casting, 16 @ 16¼c.

Pig Tin—About 24⅞c. spot for 5 and 10 ton lots, f. o. b.

Pig Lead—For wholesale lots, 4⅜c., with .02½ @ .05c. extra for carloads.

Spelter—4.10 @ 4.20c., New York delivery.

Antimony—Cookson's, 10¼ @ 10⅜c.; Hallett's and U. S., 8½c.; cheaper brands, 8¼ @ 8½c.

Lard Oil—Prime City, 80c. in jobbing lots.

Large Work by the Westinghouse Machine Company.

It is generally known that the Westinghouse Machine Company has entered the field of Corliss engine construction and has equipped its works with appliances for building such engines of the largest size. This move is an outgrowth of the enormous development of electric power stations, both in size and number. The recent equipment with electrical power of the street railways of New York and the elevated railway of Boston, the equipment of the elevated railways of New York, which is now in progress, and the equipment of the underground road of New York, which is a matter of the immediate future, are sharp reminders of the vast importance which has been reached by electrical traction. It is, moreover, known that the larger electrical companies are turning their attention to still more ambitious enterprises, that they are prepared to equip the suburban traffic of steam roads with electricity, and that they consider the conservatism and inertia which necessarily accompany such radical departures to be the chief, if not the only, obstacles to the carrying out of such plans. In view of what has already been accomplished and of what is now in progress in electrical traction, it is either a very bold or a very ignorant man who would set

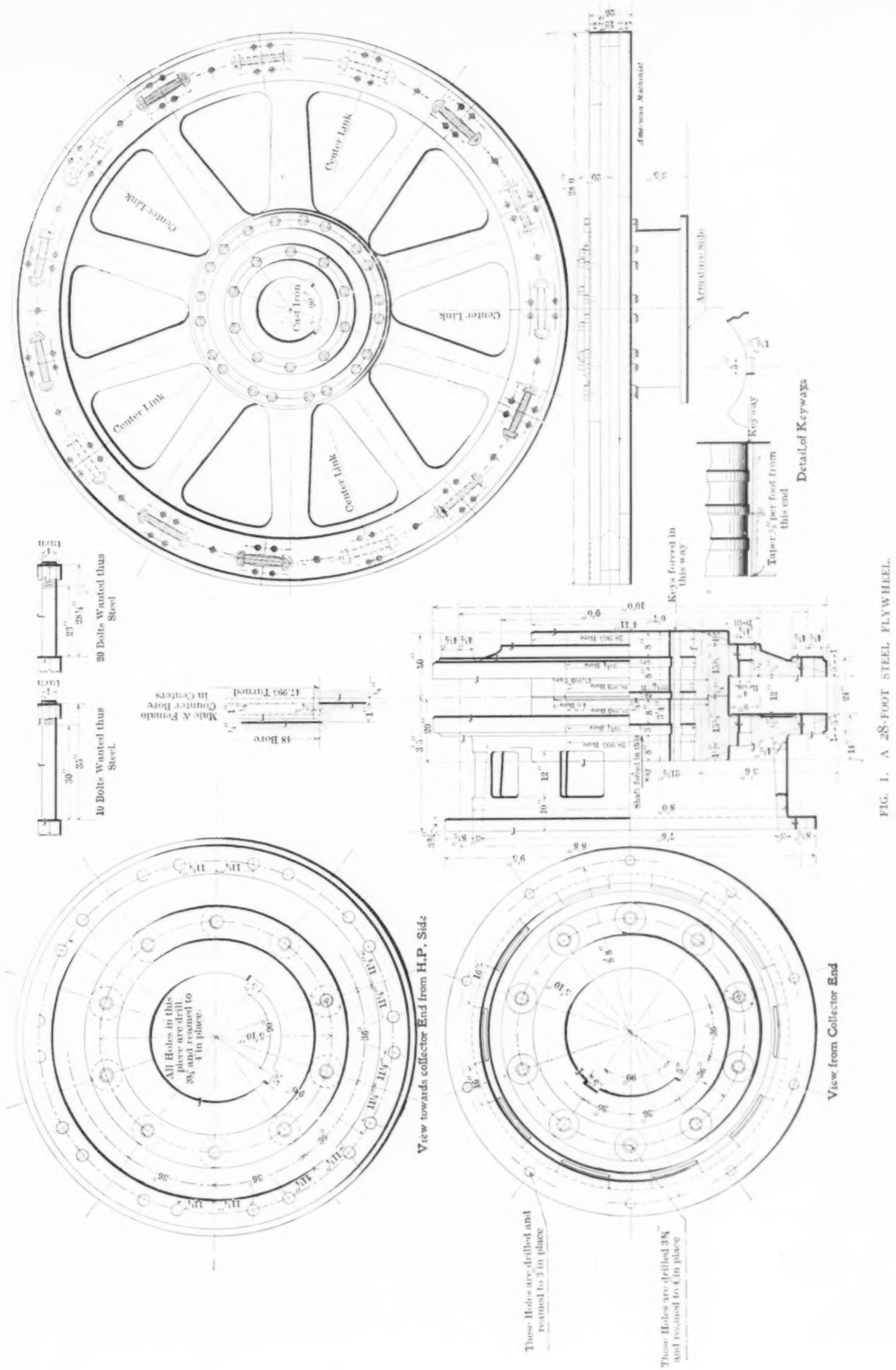

Center Link
Center Link
Center Link
Center Link
Center Link
Cast Iron
American Machinist
Armature Side
Keyway
Taper ⅛" per foot from this end
Detail of Keyways
Keys forced in this way
20 Bolts Wanted thus Steel
19 Bolts Wanted thus Steel.
Male & Female Counter Bore in Centers
17.995 Turned
18 Bore
Shaft forced in this way
All Holes in this piece are drill 3⅜ and reamed to 4 in place.
View towards collector End from H.P. Side
View from Collector End
These Holes are drilled and reamed to 3 in place
These Holes are drilled 3⅜" and reamed to 4 in place

FIG. 1. A 28-FOOT STEEL FLYWHEEL.

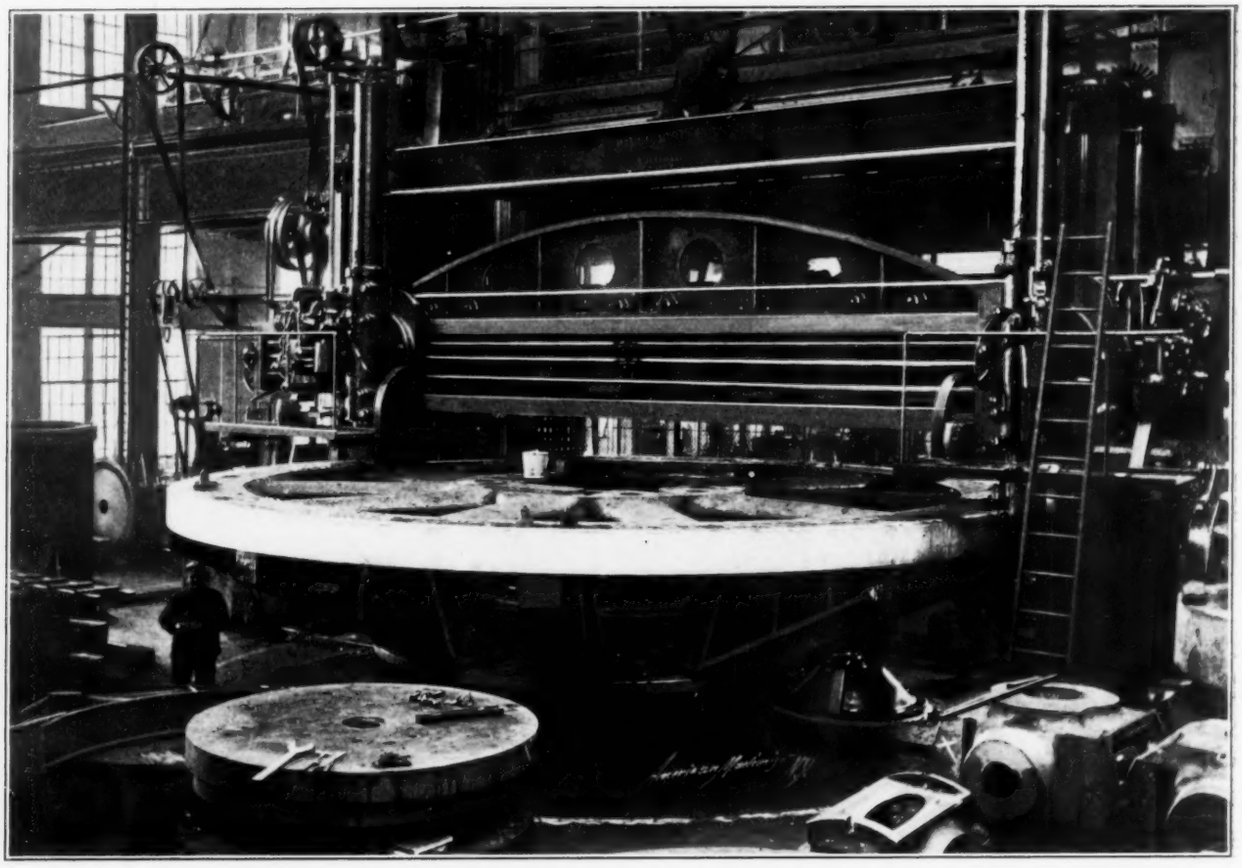


FIG. 2. A 28-FOOT FLYWHEEL IN A 30-FOOT BORING MILL.

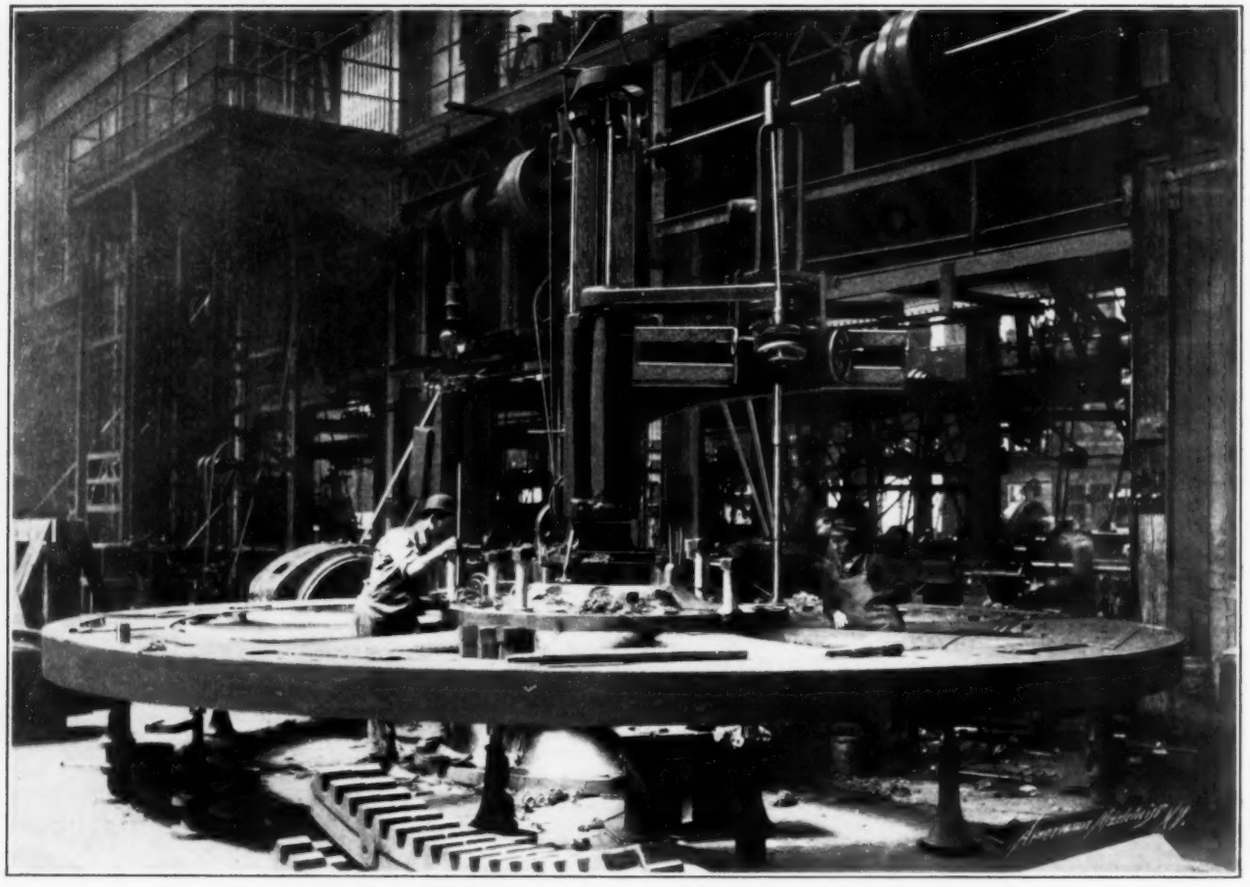


FIG. 3. DRILLING THE HUB BOLT HOLES OF A FLYWHEEL.

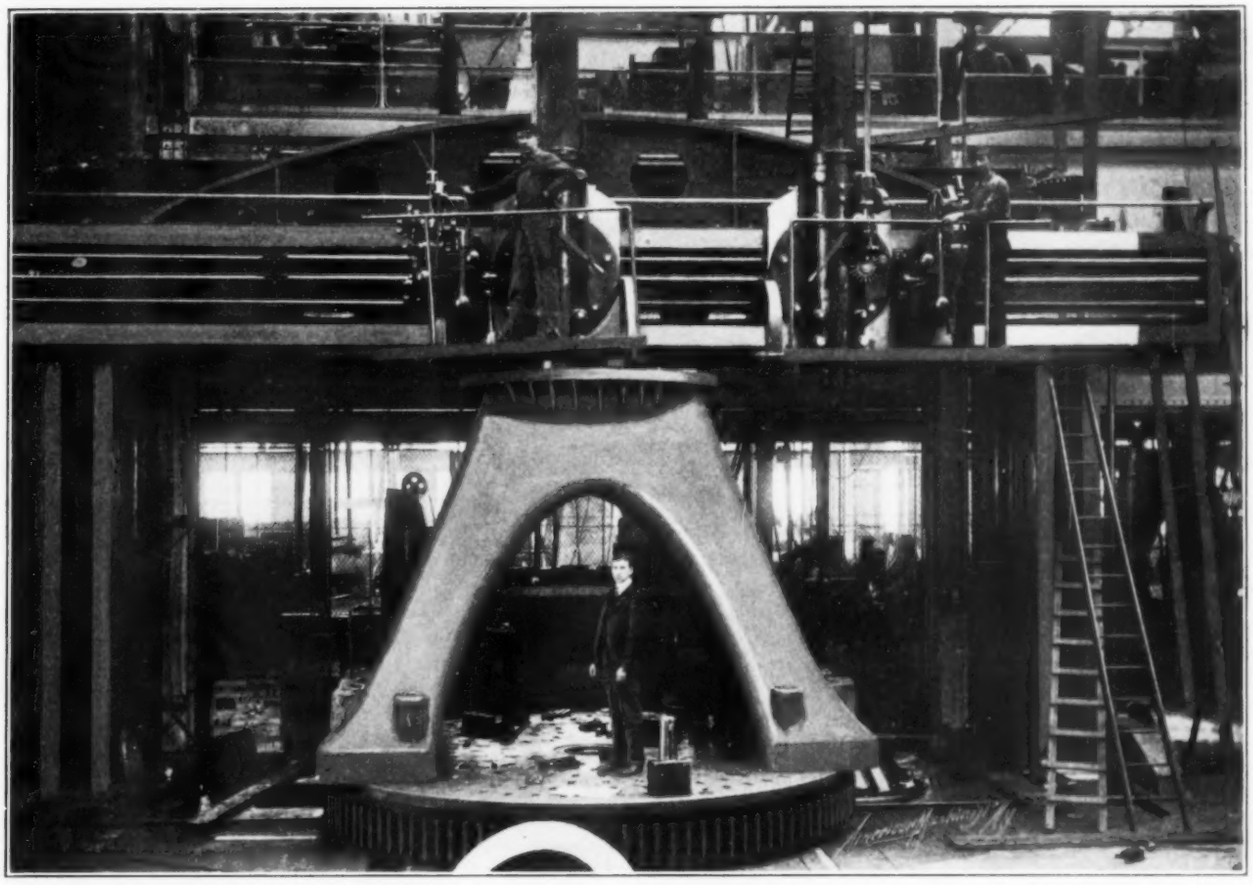


FIG. 4. FACING THE FLANGE OF AN A-FRAME.

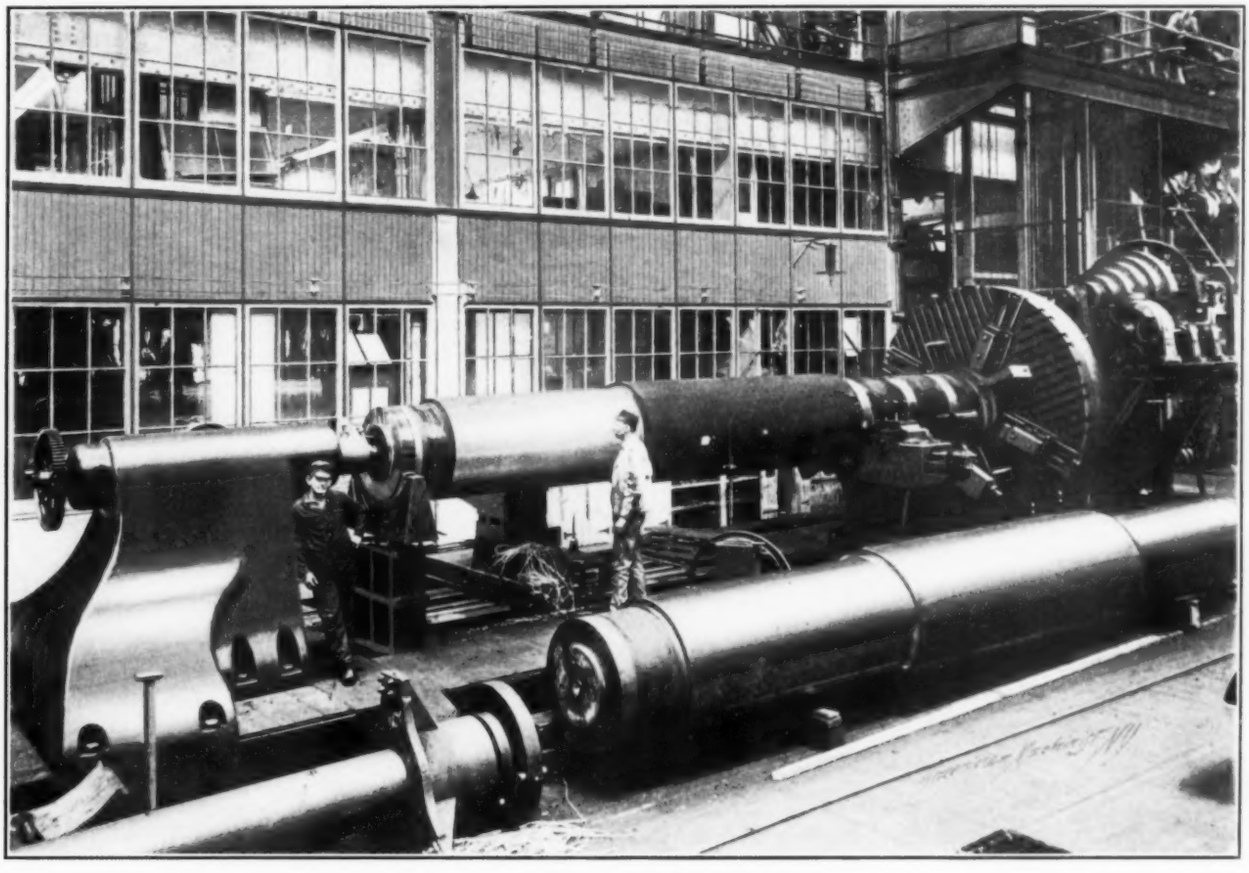


FIG. 5. A 39-INCH SHAFT IN A 12-FOOT LATHE.

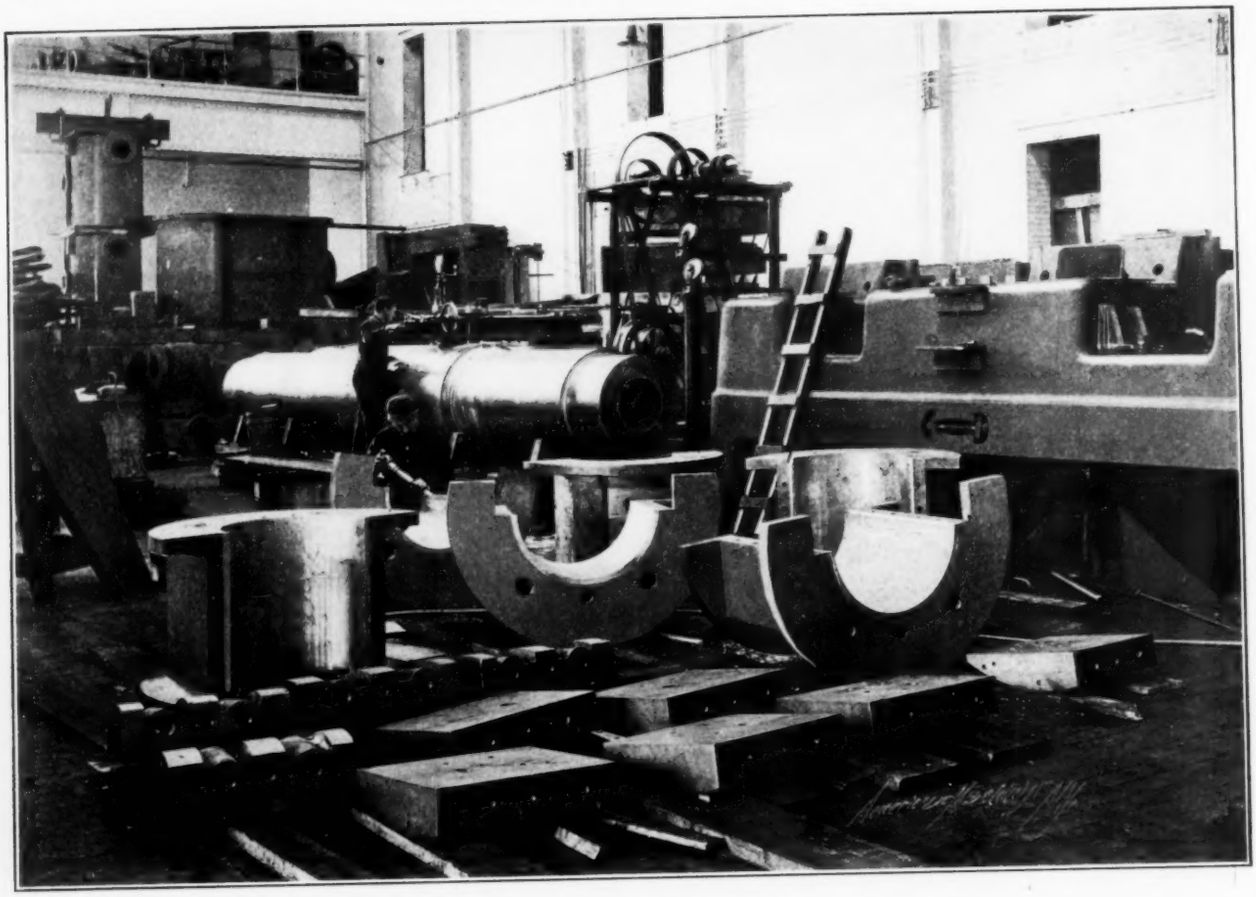


FIG. 6. KEYSEATING A 39-INCH SHAFT.

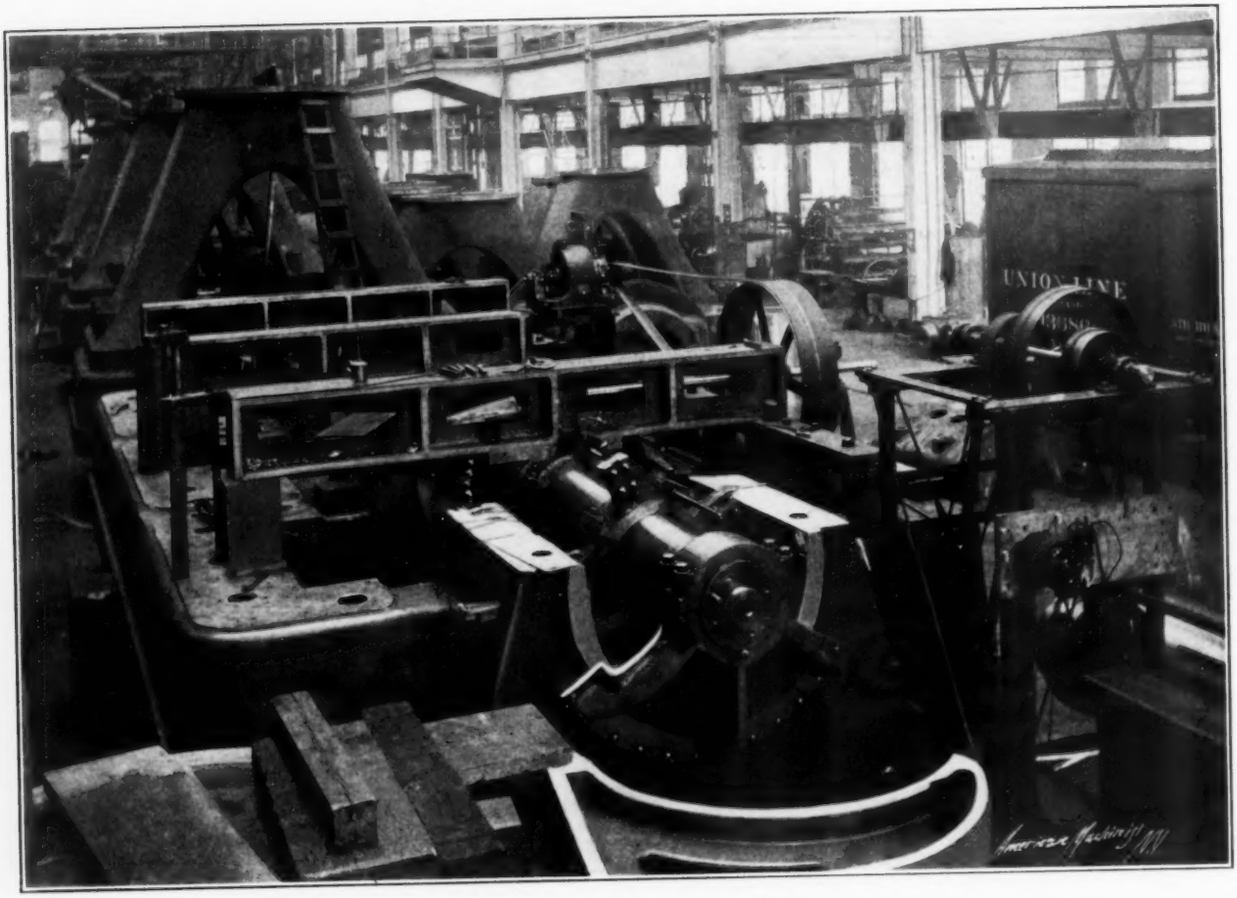


FIG. 7. A PORTABLE BORING BAR.

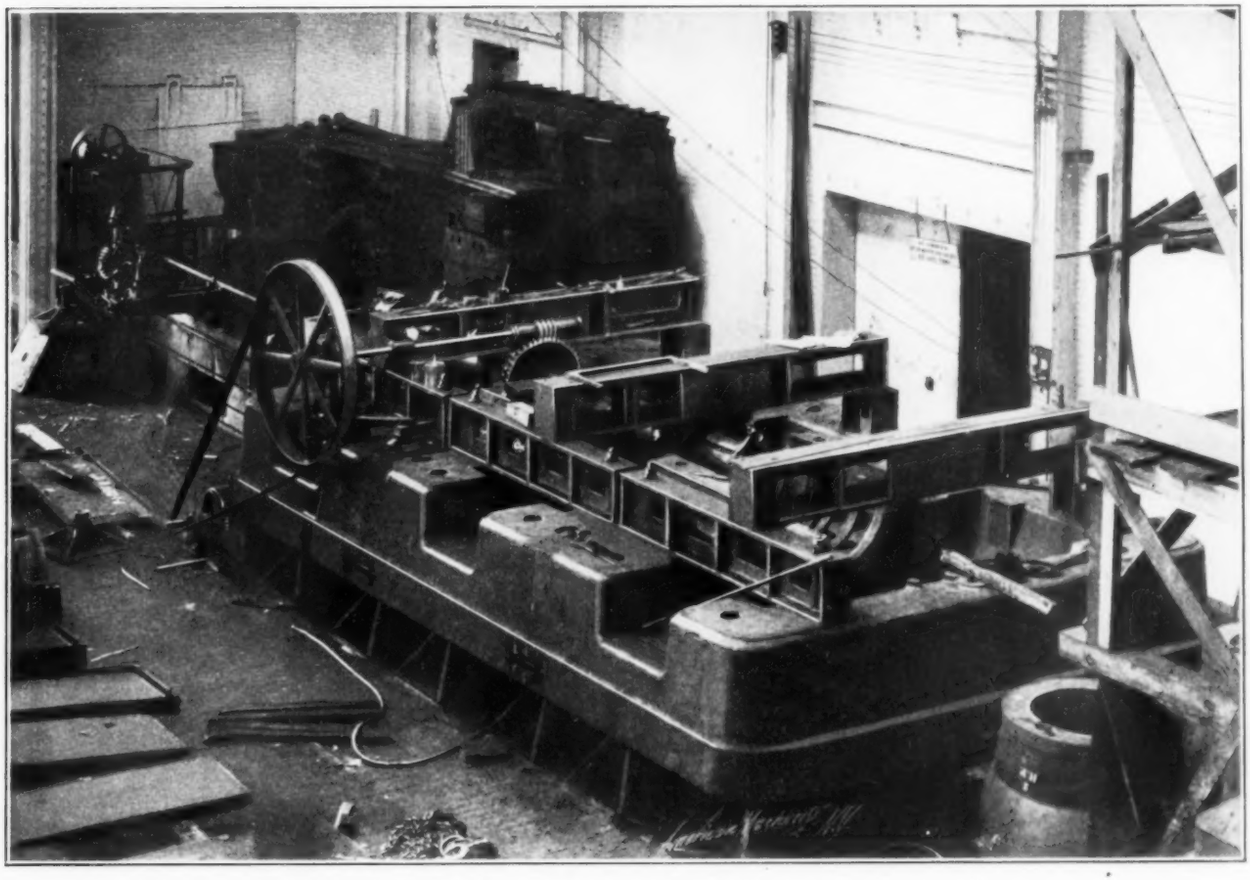


FIG. 8. ANOTHER VIEW OF BORING BAR.

any limits to what it may ultimately accomplish.

It is not long since it was an exception to find an electrical power station equipped with anything else than small high-speed engines and belted dynamos; but at the present time, when stations of 50,000 horse-power are in operation and those of 100,000 are in progress, such a construction has become entirely inadequate, and the direct-connected generator and vertical Corliss engine have become a standard type. With the Westinghouse Electric & Manufacturing Company producing electrical machinery of the largest sizes, there was an obvious field for the Westinghouse Machine Company in large engine construction, and that company has equipped itself for work of this class with a completeness which is commensurate with its opportunities. As a result, it has now under construction a large number of engines of 5,000 horse-power and thereabout, and the accompanying illustrations of the work in progress will serve to indicate the superior nature of the appliances supplied for doing it.

Fig. 1 is a working drawing of a 28-foot steel flywheel with cast-iron hub, for a 46 and 86 by 60-inch engine. The wheel rim is fitted with reinforcing plates riveted to its sides, this being the construction which, with some variations of detail, is now generally followed in flywheels for this service. The rim is in five segments,

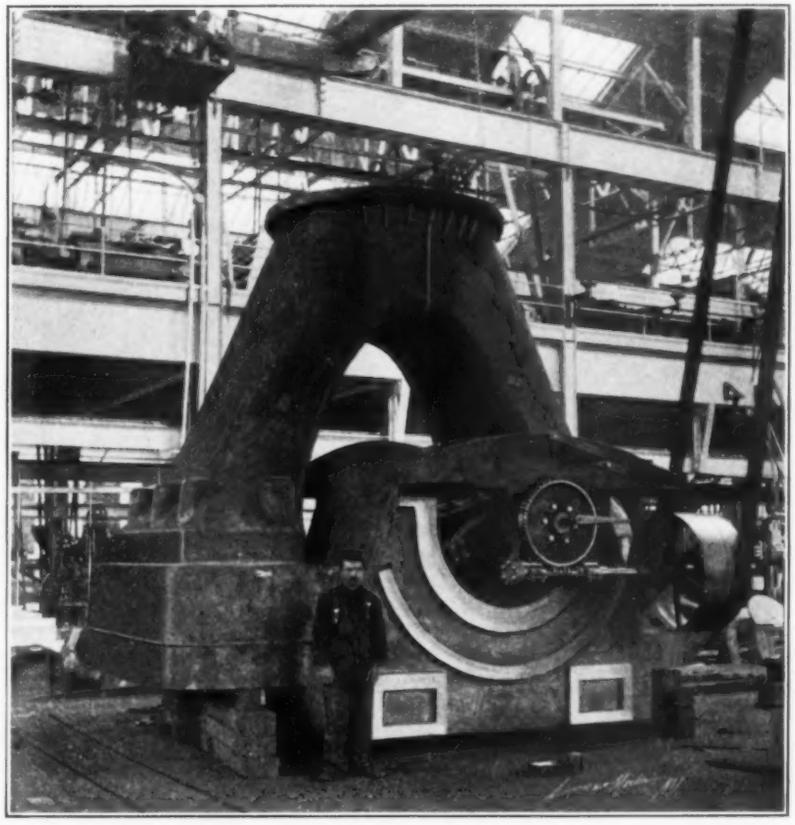


FIG. 9. A BORING RIG FOR SPHERICAL SEATS.

each having two arms, and the seven inch plates attached to each side of the rim are arranged to break joints with the rim body and with each other. The rim body joints, indicated in the drawing by the words "center link," have five 4-inch rivets on one side and ten on the other before a joint in the plates is reached, while the shrunk-in links in the plates, being located well away from the rim body joints, act to give the rim nearly, if not quite, all the reinforcement due to the entire section of the plates. These rivets are driven when the engine is in place, *cold*, by hydraulic pressure. Driven in this way the body of the rivet is swelled by the pressure to fill the holes, and thus ensure that the rivets are without slack and act as they should in shear.

The hub of the wheel carries the generator spider directly, as indicated in the detail views of the hub, the strains due to sudden changes of load being thus not felt directly by the shaft at all.

Fig. 2 shows the flywheel in place on a 30-foot Sellers boring and turning mill. The wheel is raised above the table of the mill to accommodate one side of the hub, about which the other parts are assembled. Fig. 3 shows the method of drilling and reaming the hub bolt holes of the wheel by a radial drill mounted on the hub, and Fig. 4 shows the same mill applied to a very different use—the facing

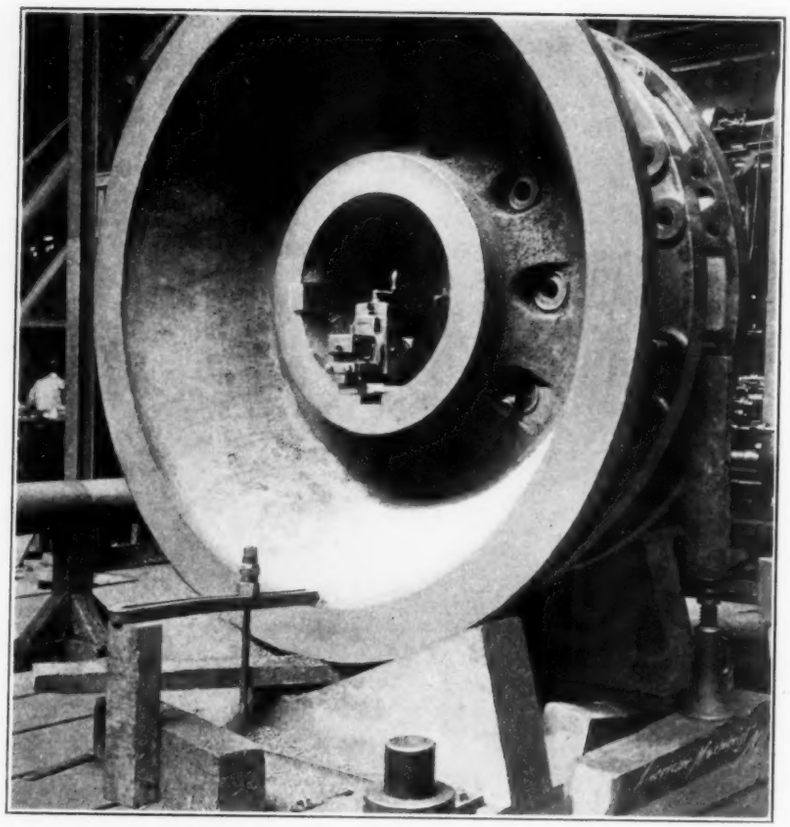


FIG. 10. KEYSEATING A FLYWHEEL HUB.

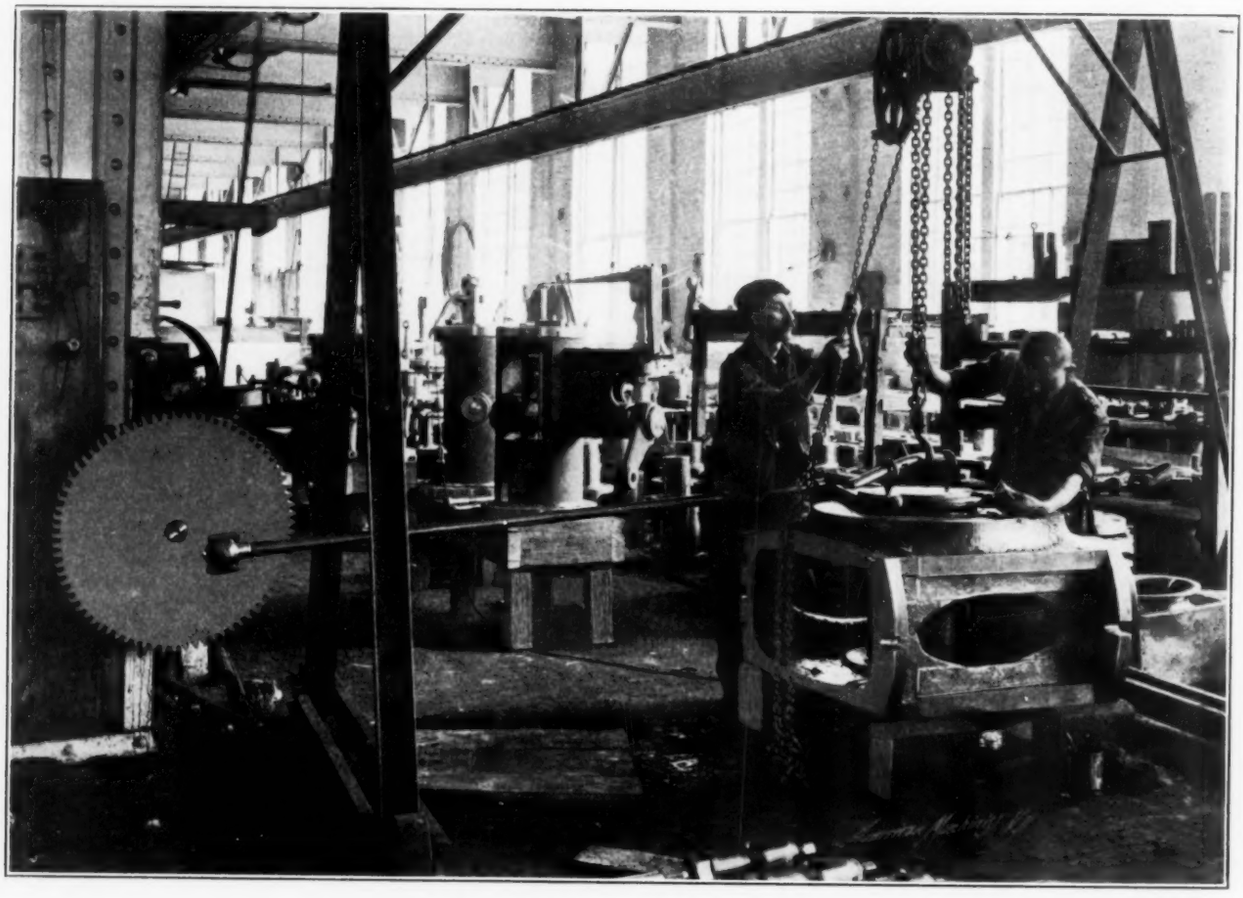


FIG. 11. GRINDING IN A CROSS-HEAD PIN.

FIG. 12. AN INTERIOR GENERAL VIEW.

FIG. 13. A ROW OF ENGINE FRAMES.

of the top flange of the *A* portion of the engine frame. Fig. 5 shows a hollow forged nickel steel shaft, of 39 inches diameter at the wheel fit, in the operation of being turned upon a Sellers 12-foot swing lathe, which is, we believe, the largest lathe yet made in this country. Fig. 6 illustrates the usefulness of a comparatively small side planing machine in doing very large work—the cutting of the keyway for one of these shafts. Figs. 7 and 8 show an unusually large, complete and mechanical portable boring bar at work on the main pillow blocks of a three-cylinder engine, boring the seats for the bearing shells. These seats are in these engines bored and not planed, and the rig shown possesses obvious advantages in the matter of ease in obtaining correct alinement. The bar is worm driven from a small portable motor placed on the floor, and is supported by two bearings carried by heavy iron parallel pieces or beams, while a third bearing, bolted to the end of the pedestal, gives additional stiffness to the cut. The pads on the bed pieces, on which the *A* frames of the engine are to rest, are first planed, and this being done and the pieces of the bed properly assembled, the parallel pieces and blocks serve to aline the bar quickly and positively. Fig. 9 shows another rig for the same purpose which is used on two-cylinder engines. Such engines carry the dynamo between the cylinders and have overhung cranks and two main bearings only. With but two bearings to a shaft, it becomes possible to use self-adjusting ball and socket bearings, similar in principle to those used on line shaft hangers, and this is done. The rig shown in Fig. 9 is for boring the spherical seats for these bearing shells, although the picture does not show it as well as might be desired. The tool does not traverse endwise in boring the sphere, but is attached to a swinging arm pivoted on the bar at the center of the bearing, and the feed swings this arm about its pivot. One of these spherical-seated shells happens to be located in the foreground of Fig. 8. Fig. 10 is another illustration of a small machine doing a large piece of work—a Morton draw-stroke shaper cutting a keyway in a fly-wheel hub. Fig. 11 shows a power rig for grinding in a cross-head pin, by which the oscillating motion that in smaller work is given by the hands of the operator is here given by the crank and connection, while the occasional lifting necessary to avoid the scoring is done by the chain block. The connecting rod is attached to a strap, which can be loosened on the pin, so that the latter can be shifted occasionally. Figs. 12 and 13 are interior views of the shop, which speak for themselves.

"Shopping Around."

This is common, everyday English for "getting estimates"; and these lines are intended to show the value of applying to more than one place to get prices on anything which one wants to get made. It often happens that some shops will be rather over-equipped with milling machines and under-equipped with emery wheels; that some can do drop-forging cheaply enough to make up for the extra cost in their city or shop of hand labor required to finish up the dropped pieces; that one shop would mill a wide slab like a printing-press bed or a paper-cutting machine table, and so on all along or around the line or cycle of shop operations. One foundry may have a row of molding machines (without the "u," to which our English brethren adhere) and squeeze up cores in the old-fashioned boxes, or *vice versa;* and thus it goes that the actual cost varies as much as 100 per cent. As to the profit—that varies also. Some will add 20 per cent., and be glad to get it; others again work on the basis of the "Dutchman's 2 per cent.," keeping their books by Dudenheimer's system of double entry—everything that costs $1 to be charged at $2.

I am assuming in the foregoing that estimates are submitted from sample pieces made on which to bid. When this is done, the "personal equation" of the foreman or the estimate clerk, or whoever makes out the supposed "cost," comes in on horseback.

I may instance from German practice—which, I assume, will do as an illustration—that stamped-up pieces which one of the largest concerns in the country wanted to deliver us by the hundred thousand at 4 pfennigs each, are offered us by another establishment at half a pfennig each. The first establishment, which is much better capitalized and equipped than the second, got its foreman to say about what it would cost to make "some" of the pieces. The second, seeing a good order behind the request for estimate, made a pair of dies and sent a thousand pieces on as a sample, with a bid at one-eighth the price quoted by the other, and a polite request that if we found the prices of others lower, we would at least take the dies, costing 40 marks (rather less than $10) and what stock they had worked up (3,000 pieces at ⅛ cent) off their hands. The reader may readily imagine which estimate and shop got the persimmon.

I recently sent out, with blueprints carefully dimensioned and specifications carefully worded, requests for estimates on a lot of spur gear wheels and rather long pinions (all cast), and got the following estimates per wheel in quantities of ten:

	Spur	Pinion
Shop A	m.18.	m.3.75
Shop B	17.50	5.
Shop C	13.	4.20
Shop D	21.	3.50

Shop C had a molding machine and a core machine; shop A had a core machine and no molding machine; shop D happened to have a pinion pattern, because it had made similar wheels before for the same concern, but the spur-wheel pattern was on the retired list, being a veteran of the war of 1870.

In getting estimates for a steel piece requiring to be forged and then turned, and for other steel pieces needing only cutting from the bar and finishing up a bit on the grindstone or emery wheel, I got the following bids on 256 pieces of each:

	Piece No. 1	Piece No. 2
Shop A	m.6.50	m.1.75
Shop B	3.	.54
Shop C	2.50	1.20

Adding these together, we find that if an equal quantity of each be taken, the price per output is as follows:

Shop A	m.8.25
Shop B	3.54
Shop C	3.70

In this case B gets it.

If, however (as is most likely the case), we shall need at least two of the ground pieces to one of the forged and turned, the bids show up as follows:

Shop A	m.10.
Shop B	4.08
Shop C	4.90

This is again in B's favor.

Should, however (which is a possibility), our customer decide to make the ground pieces himself, or has found someone to underbid us, or we find a shop that can make them even more cheaply than B, then, as B's bid is for the two things (which belong together and must fit exactly, and the forged piece of which might be forged over the other) together, and as he refuses to make the forged pieces unless he makes the ground ones too, then (as the other shops will make either lot without the other) C gets the order for the forgings.

But what sort of a bid must we put in after adding our profit?

On smaller sizes of Nos. 1 and 2, the bids are as follows, from the same shops:

Shop A	m.5.50	m.1.50
Shop B	3.	.47
Shop C	2.40	1.

On these bids, as on those for the larger sizes, A and C will deliver either piece 1 or piece 2 without the others; B must make at least one of piece 2 for each of piece 1, or he doesn't want the job.

If now our customer is willing to let us deliver one size of 1 and 2 and not the other, we are again in a quandary, for we don't know what the demand for either size would be, nor does he.

The moral to be extracted from these figures is, that it pays to get estimates from more than one shop, and for each piece separately. ROBERT GRIMSHAW.

Dresden.

A Multi-Spindle Drilling and Tapping Attachment and Work Fixture, for the Turret Lathe.

BY WILLIAM DORAN.

The special multi-spindle drilling and tapping attachment and its work fixture, shown in the accompanying illustrations, were designed by the writer. The work, shown in Fig. 1, is a circular casting with a large central hole and six small holes *a a*. It was for drilling and tapping these six holes that the attachment here shown was designed, and as it proved a great cost reducer and allowed the required degree of interchangeability at the minimum of cost, its adaptability for a large variety of work is apparent. It also shows another use to which the ever handy and often idle turret lathe may be put.

The six holes of the casting are equally divided around a circle concentric with the large hole *c c*, and are drilled entirely through the bosses. The large hole is bored and one side of the bosses faced in a preceding operation in the turret lathe, and the keyway is let in so as to be in the same relative position to the bosses in all of the castings.

Fig. 2 shows, partly in section, the fixture complete and also several of the main parts. Fig. 3 is a plan, with the arrangement of the gears and their relative positions on the stationary spindle disk. As shown in Fig. 2, the attachment consists of three main parts, of which *A* is the driver, *C* the stationary spindle plate and *D* the driving gear spindle and leading stud. The driver *A*, of cast iron, was finished first, boring it out at the back and threading it to fit snugly the spindle of the turret lathe. A hole was then bored straight through from the face at *B* and threaded as shown, getting it dead true. The front was then faced, and a cut was taken off the outside. A small, round-nosed tool was then used, and a spiral oil groove was cut into the face, thus insuring the lubrication of the entire surface.

The stationary disk *C*—a circular casting with bosses on each side to the number of thirteen on the front and seven on the back—was then machined. The central hole for the spindle *D* was first bored and reamed to size; a mandrel was driven in and both sides were faced, leaving all the bosses the same hight. We were now ready to locate and finish the holes for the six spindle gears *H* and the intermediate gears *K*. A stud of tool steel was turned up, hardened and ground to fit the central hole in the disk tightly. We then finished up six buttons of the type used for accurate jig making, and ground them to 7/8 inch on the outside and the ends perfectly square. The central stud was entered into the hole and one of the buttons was located the exact distance from the center by using the verniers and deducting half the diameter of the stud and the button. The button was then fastened to the disk by its screw, being located as nearly in the center of the boss as possible. The second button was located the required distance from the first and from the center of the stud in the same manner, and this operation was repeated until all six buttons were located.

The disk was clamped on the lathe faceplate and the central stud removed. The first button was trued and removed, and a 1/2-inch hole drilled, bored and reamed entirely through the disk. The next button was then located, trued and removed and the hole bored and finished in the same manner, repeating until the six holes were finished. We were now sure of the accuracy and position of the gears when placed and the interchangeability of the holes when drilled. Before drilling and tapping the holes for the six intermediate gears, the gears were turned and cut.

The drill chuck spindles and gears were each in one piece and were mild steel forgings which were first centered and faced the same length. The spindle portions *G* were turned to within .005 inch of the finish size and the ends threaded for the nut leaving a shoulder for the washer. The

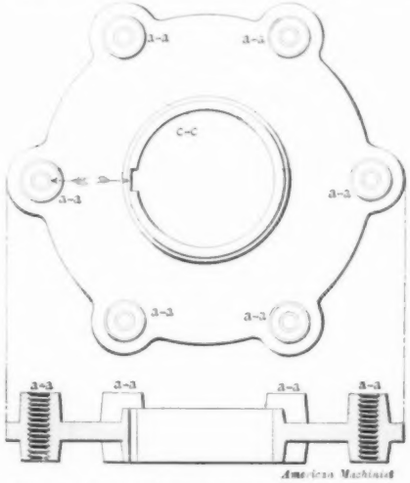


FIG. 1. THE CASTING TO BE DRILLED AND TAPPED.

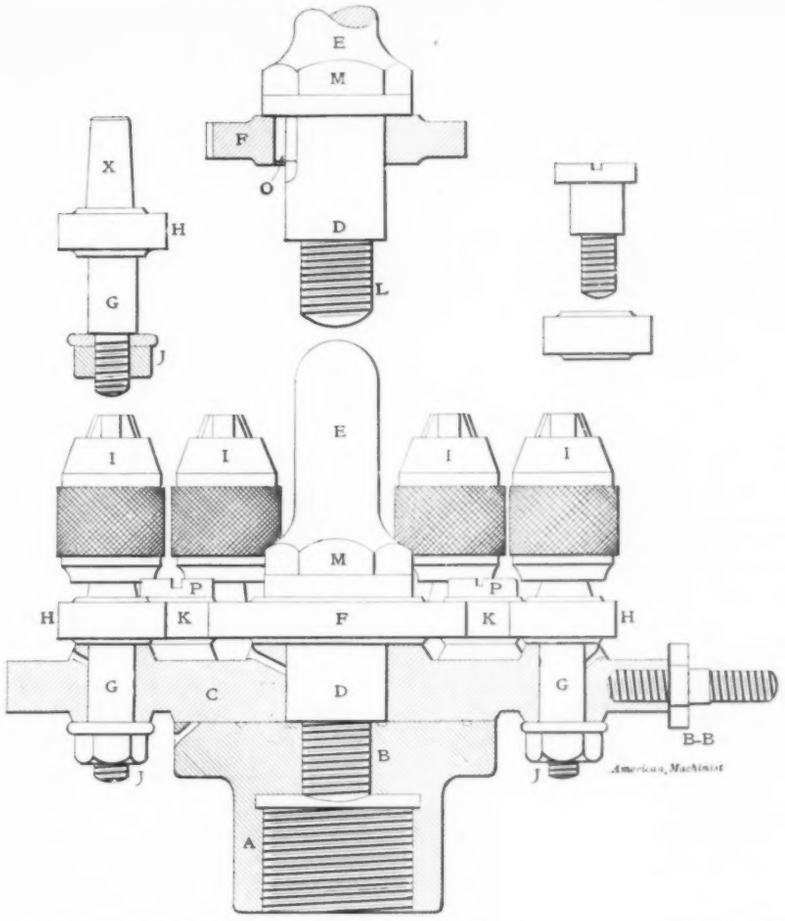


FIG. 2. MULTIPLE SPINDLE DRILLING AND TAPPING ATTACHMENT FOR THE TURRET LATHE.

FIG. 3. ARRANGEMENT OF GEARS ON THE STATIONARY DISK.

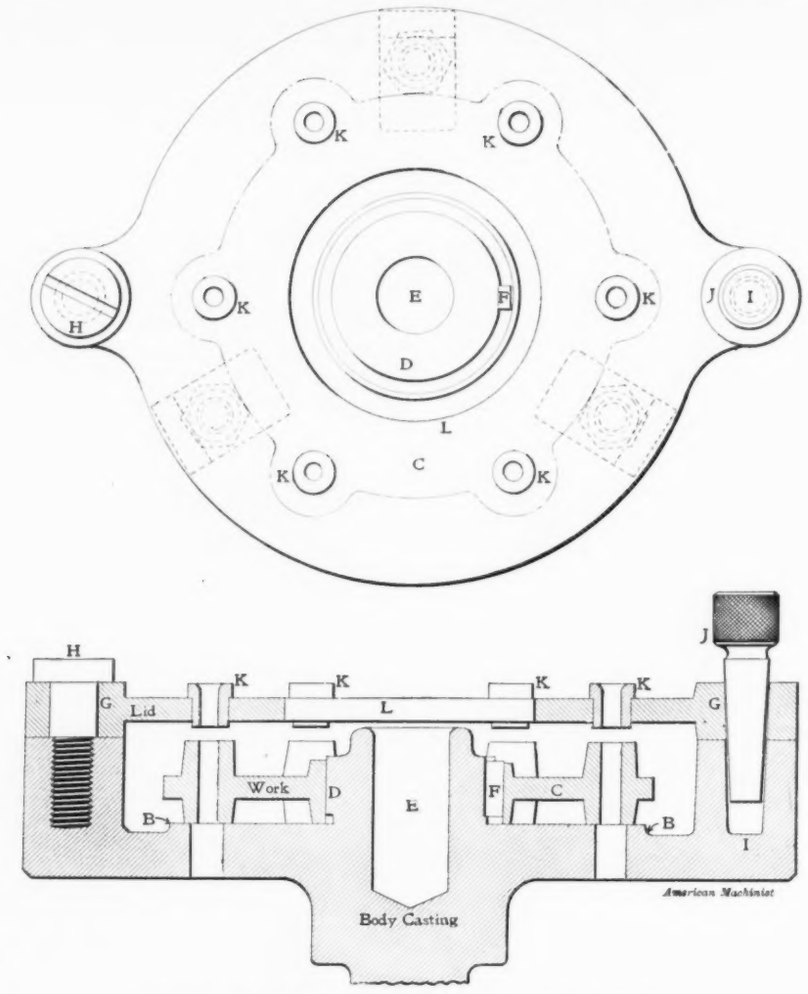


FIG. 4. TURRET HEAD FIXTURE FOR HOLDING THE WORK.

taper portion for the chuck was turned, leaving the same amount of stock for finishing as on the other end. The gear portion *H* was then finished to the required diameter, and all were finished in the grinder, with the portion *G* a smooth running fit in the reamed holes in the disk and the sides of the gears ground perfectly flat and true with the spindles. The teeth were then cut.

The six intermediate gears *K* also were of steel, and six shoulder studs or screws were made of tool steel for them. The large or driving gear *F* was of cast iron and was bored and reamed to the same size as the central hole in the disk; the sides were ground as the others and a keyway let in for fastening it to the spindle and leading stud *D*. The portion *D* of the stud was turned to within .005 inch of the finish size, the keyway let in and ground to a smooth-running fit within the disk after hardening. A second shoulder was left at *M* so that the space between it and the first would accommodate the disk and the driving gear. A hexagon was milled at *M* and the stud reduced for the remainder of its length, the end rounded to act as a leading stud and enter a reamed hole in the work fixture when in operation and support it. The six holes for the intermediate gear screws were then drilled and tapped, so that the gears would occupy the positions shown in the plan. After drilling and tapping the hole for the stud *B B* all parts were assembled, as shown, the chucks being driven tightly on to the spindles.

The fixture for locating and fixing the work is shown in Fig. 4. The body casting is machined first. After being centered it has the stem turned to fit the hole in the turret head; it is then reversed and held by the finished stem in a nose chuck and the front is finished, first taking a cut off the two projecting bosses *G G*, then finishing the seat for the work and turning the hub *D* to fit nicely the large central hole in the work (undercutting it at the back to prevent dirt or chips from accumulating) and lastly boring and reaming the center hole *E* for the leading stud of the drilling and tapping attachment. Before locating and letting in the key *F* in the hub *D* the lid was finished and fastened to the body casting and the holes for the drill bushings were let in.

This lid casting is circular, with a large hole *L* in the center and raised bosses at opposite sides where it is hinged and located to the body casting. These bosses were faced and a cut was taken off one side of the casting for the bushing heads to locate. The lid and the body casting were then clamped together, so that the boss faces rested true with each other, and the hole for the hinge screw *H* was let in, tapping it in the body casting and enlarging and reaming it to a snug fit for the large portion of the screw in the lid. The screw *H* was then let in and the hole *I* drilled and reamed for the taper locating stud *J*. We were now ready to locate and finish the bushing holes. The taper locating pin *J* was forced in lightly and a hardened and ground plug was finished to fit tightly the hole *E*. Then by using the buttons used for locating the spindle holes in the drilling and tapping attachment these six holes were located in the same manner. The hinge screw *H* and the locating stud *J* were then removed, the lid was clamped to the face-plate, the buttons made true and the holes bored and reamed to the required size. The bushings *K* were made of tool steel and forced into the holes in the lid. Three holes were then drilled and tapped in the body casting in the positions shown by the dotted lines in Fig. 4 to accommodate the clamp screws.

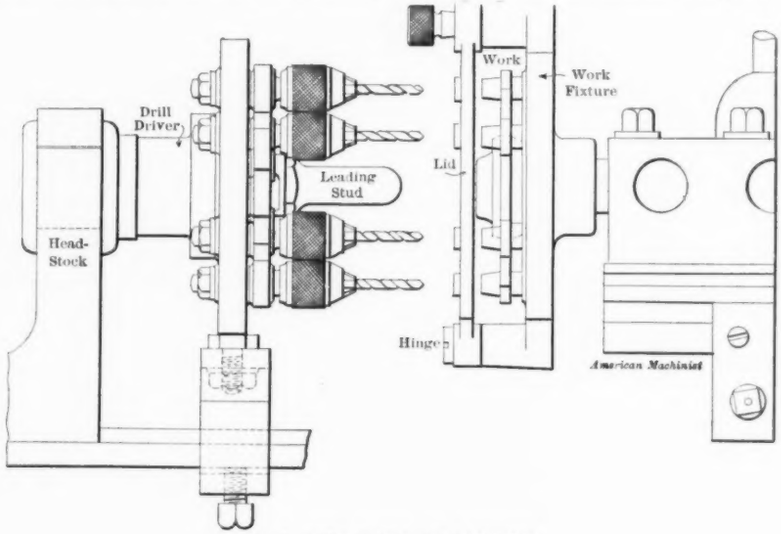


FIG. 5. THE PARTS IN POSITION.

These three clamps are only used when tapping the holes, the lid being then removed. After the six clearance holes for the drills and taps were drilled and the key let in so that the bosses of the casting would come approximately correct, the fixture was complete.

In Fig. 5 is shown the manner of setting up the multi-spindle attachment and the work fixture. The driver or back-plate of the attachment is screwed on to the spindle of the turret lathe. A clamp strap of ⅜ inch thick flat iron, bent to the shape required, with a hole in the center for the stud *B B*, Fig. 2, and the ends bent inward and set-screws let in, was then secured with the ends fastened to the body of the lathe and the stud *B B* fastened to the strap by the nut, thereby locating and fastening the spindle disk without the possibility of shifting when in operation.

The work fixture was located by entering the stem into one of the holes in the turret head, the slide moved up and the fixture manipulated until all six drills entered the bushings of the fixture. The fixture was then fastened securely. The lid of the fixture was thrown back, the work or casting to be drilled located by the key on the hub of the fixture, as shown, and the lid or bushing plate relocated by the taper plug. The lathe is started, and as the driver revolves and with it the driving gear, the spindle disk remains stationary, allowing the six drills to turn at the speed desired. The turret slide is moved up, the six holes are drilled in the work, the finished piece removed and replaced by another, and the operation repeated. After all the castings in the lot have been drilled they are tapped by simply substituting taps for the six drills and removing the bushing plate from the work fixture. The locating of the castings so that alinement of the drilled holes with the taps will be perfect is accomplished without any trouble, as the keyway in the casting brings them in the same location, as in the first or drilling operation, and the three clamps hold it tightly in position. When tapping the spindles are run at the proper speed and the work is brought up to the taps, the operator keeping his hand on the shifter, and as soon as the taps have come through the holes the lathe is reversed and the taps are fed out.

Shop Foremen.

Some years ago John Richards delivered a series of lectures before the students of Leland Stanford Junior University, at Palo Alto, California, his subject being, "Works Administration." These lectures contain much that is interesting and valuable to others besides students—in fact, much that can be made better use of by shopmen than by students. The following is what he had to say in one of these lectures on "Shop Foremen":

In the first lecture the ideal foreman was mentioned as a mythical person, and is so if he be expected to perform the duties commonly ascribed to this position, but at this day a good many of the duties once performed by a foreman have disappeared. The draftsmen have taken his place. I can remember very well when a foreman gave out all kinds of instructions for the work in the smaller machine shops in this country. The drawings, if any at all, for use in the machine shop consisted of general elevations in two planes, abundantly tinted with colors, but no dimensions marked. These were supplied to the foreman, who laid out the work, and every little thing had to come under his notice.

He was responsible for the work, the performance of the workmen and for the proprietors also, because the supplies, discipline and everything throughout were under his charge. He alone was responsible in an executive sense, and the man on whom all depended. He got the credit of success, and bore all the odium of mistakes and failures.

With detail drawings came new conditions. The foreman interpreted the drawings when they were obscure, but responsibility was shifted to the drafting room and to specifications; but the foreman found still quite enough to do in other ways, and remained an authority for many things that cannot enter into drawings, but under the present system in machine works the general foreman's executive duties have gone over to a manager and special foreman, or leading workmen set over departments.

I think useful suggestions may arise out of some personal experience in respect to foremen. I had the misfortune to rise to this function at eighteen years of age; not over a great charge, but one of some responsibility, and from then on for twenty years or more was associated with the methods of a general foreman, and could not help noticing various "hitches" that arose in that system.

Then occurred some experience in Europe, where the methods of organization were different, and not applicable, as I supposed, in this country; but in 1884, when a business founded in San Francisco had grown up to employ a hundred men, this matter of a foreman began to assume a problem of much difficulty.

The work made was machine tools, steam engines, hydraulic apparatus and mill gearing or general work, it might be called, consisting of shafts, pulleys, special work and repairing; so there were four separate classes of work carried on, besides the shop departments of wood work, pattern making and forging. Several foremen, all of them fairly competent men, were tried, but it was found beyond their powers to manage the different departments. A man conversant with steam engines did not understand hydraulic work, and one who could manage the hydraulic department could not deal with machine tools or steam machinery.

Finally the shop was divided up into sections under five workmen, selected from each branch of the work because of their skill, and these men were paid extra for acting as the head of their department and being responsible. The shop machine tools, so far as possible, were set off to these departments, and such tools as could not be segregated operated first for one and then another department, being for the time under the charge of the foreman in that division.

The men were all young, ambitious, and for many years this went on without a clash, except the first day, when one of the workmen came into the office to find out who he was working for. He was informed that this could not be determined in the office, but his right to ascertain was fully conceded, and as there might be some difficulty under our system he better go at once to some other shop where there was but one foreman. This was the first and last case of the kind. An arrangement of this kind exists in the case of contract work, or other systems of an analogous nature, both in this country and in Europe—indeed has to exist where workmen are responsible for what is called discipline or authority.

In a very large works there is commonly a staff, as at the Union Iron Works, in San Francisco. There is a manager over all, then a works superintendent of the fitting or machine department, a marine superintendent, a shipbuilder, chief draftsman of the engineering department, and one of the shipbuilding department, an electrician, and so on. The division of duties is not often the result of a concerted plan, but follows generally as a matter of evolution in each works, because the division of duties is very different in various kinds or branches of work. The general foreman of former times has disappeared.

The terms discipline and responsibility have been several times used, and in these is to be found the key to management in a large works of any kind. In a former lecture it was attempted to show that the efficient performance of duty depended on responsibility, and the more the subject is investigated the more will this become apparent. The same rule applies to discipline, which is sometimes a very difficult matter to deal with in a works.

I doubt if this can be made apparent by words alone, but it will become a very tangible portion of managing duties in future, as you will find, because an aggregation of people all striving to better their condition, improve their skill and position, are necessarily in competition one with another. It is a law of nature, and inseparable from aggregated or community life, extending to the brute creation, and even down to insect life.

Jealousies arise, and to manage so as to maintain harmony among a body of workmen and the staff of a works where there are no defined rules of law to guide, some-

times surpasses human powers. It is an ethical study, which, if perused, would lead far away from the subject under discussion; but to make it more clear, and to gain suggestions, I will go outside of the industrial field for some illustrations.

About thirty years ago, Dr. Holbrook established at Lebanon, in Ohio, a normal school, the purpose of which was to prepare teachers for the schools in that State, and the doctor, being quite a student of sociology, hit upon a happy expedient of avoiding the cares of discipline. The students, who were mainly adults, were assembled at the beginning of each term and informed that the doctor and his aids had quite enough to do in giving instruction, and the school must govern itself. He recommended the adoption of formulated rules so far as these would apply, to be voted for or signed by the students, which has since been done at the beginning of each new term, and the scheme has, so far as I know, been a complete success.

The other extreme, that of authority in maintaining discipline, exists at sea, where a commander is clothed with absolute authority over the crew of his vessel, amenable to the laws of his country when he reaches a port; but while at sea he is unrestrained in the exercise of any reasonable, or even unreasonable, function. By tradition, superstition and necessity the system is successful, but is not one from which suggestion can be drawn for the management of a works.

One other example can be cited, showing that the natural tendency of people is to order and discipline. In London there are a large number of places of amusement, called music halls, most of them quite respectable, and all of them extensive. The admission fee is small, and the risk of disorder is great even in that city, where order is very rigidly enforced. It was discovered that the best way to maintain order in these public music halls was to make the audience responsible. A chairman, representing the audience, sits in front of the stage, facing the people; he announces the plays, criticises the performance, and apparently controls everything on behalf of the audience, to whom he appeals in case of a dispute. The theory of the scheme is correct; the teachers in a college or school, or those who have to conduct a works, should not be taxed with the maintenance of discipline and order among their pupils or workmen.

In industrial establishments rules relating to discipline should appeal to the self-respect and responsibility of those to whom the rules are directed. Posted notices of a paternal or arbitrary form commonly do no good, and frequently a good deal of harm. When such posted rules are required it is easy to put them in the form of an agreement or request, and to say that the owners or management deem such rules expedient for the good and interest of all concerned.

It must be remembered that at this day in the higher class of skilled industries, workmen occupy a position quite different from former times, and sometimes outrank by education and a fair social standard those who employ and manage, but even if this were not the case there will be found much truth in the old French adage that "courtesy costs nothing and buys a great deal."

The Coarse-Grainedness of Matter.

Matter in bulk appears to be continuous. Such substances as water or air appear to the ordinary observer to be perfectly uniform in all their properties and qualities, in all their parts. The hasty conclusion that these bodies are really uniform is, nevertheless, unthinkable. In the first place, the phenomena of diffusion afford conclusive proof that matter when apparently quiescent is, in fact, in a state of internal commotion. I need not recapitulate the familiar evidence to prove that gases and many liquids when placed in communication interpenetrate or diffuse into each other; or that air, in contact with a surface of water, gradually becomes laden with water vapor, while the atmospheric gases in turn mingle with the water. Such phenomena are not exhibited by liquids and gases alone, nor by solids at high temperatures only. Sir W. Roberts Austen has placed pieces of gold and lead in contact at a temperature of 18 degrees Cent. After four years the gold had traveled into the lead to such an extent that not only were the two metals united, but, on analysis, appreciable quantities of the gold were detected even at a distance of more than 5 millimeters from the common surface, while within a distance of ¾ of a millimeter from the surface gold had penetrated into the lead to the extent of 1 ounce 6 pennyweight per ton, an amount which could have been profitably extracted. Whether it is or is not possible to devise any other intelligible account of the cause of such phenomena, it is certain that a simple and adequate explanation is found in the hypothesis that matter consists of discrete parts in a state of motion, which can penetrate into the spaces between the corresponding parts of surrounding bodies.

The hypothesis thus framed is also the only one which affords a rational explanation of other simple and well-known facts. If matter is regarded as a continuous medium the phenomena of expansion are unintelligible. There is, apparently, no limit to the expansion of matter, or, to fix our attention on one kind of matter, let us say to the expansion of a gas; but it is inconceivable that a continuous material which fills or is present in every part of a given space could also be present in every part of a space a million times as great. Such a statement might be made of a mathematical abstraction; it cannot be true of any real substance or thing. If, however, matter consists of discrete particles, separated from each other either direct by empty space or by something different from themselves, we can at once understand that expansion and contraction may be nothing more than the mutual separation or approach of these particles.

Again, no clear mental picture can be formed of the phenomena of heat unless we suppose that heat is a mode of motion. And if heat be motion there can be no doubt that it is the fundamental particles of matter that are moving. For the motion is not visible, is not motion of the body as a whole, while diffusion, which is a movement of matter, goes on more quickly as the temperature rises, thereby proving that the internal motions have become more rapid, which is exactly the result which would follow if these were the movements which constitute sensible heat. Combining, then, the phenomena of diffusion, expansion and heat, it is not too much to say that no hypotheses which make them intelligible have ever been framed other than those which are at the basis of the atomic theory.

And here it is necessary to insist that all these fundamental proofs are independent of the nature of the particles or granules into which matter must be divided. The particles, for instance, need not be different in kind from the medium which surrounds and separates them. It would suffice if they were what may be called singular parts of the medium itself, differing from the rest only in some peculiar state of internal motion or of distortion, or by being in some way ear-marked as distinct individuals. The view that the constitution of matter is atomic may, and does, receive support from theories in which definite assumptions are made as to the constitution of the atoms; but when, as is often the case, these assumptions introduce new and recondite difficulties, it must be remembered that the fundamental hypothesis—that matter consists of discrete parts, capable of independent motions—is forced upon us by facts and arguments which are altogether independent of what the nature and properties of these separate parts may be.—From address of ARTHUR W. RUCKER, President of the British Association for the Advancement of Science.

Making Bicycle Wrenches.

BY VER. I. NIER.

It is not my purpose in this article to deal with the production of high-class bicycle wrenches, but, instead, I wish to describe the making and the use of the tools for producing a medium-priced wrench. The operations on this particular wrench have been reduced until it is believed that they are the lowest in number that the work can possibly be produced with, using a single-acting power press. The stock for the main part of the wrench is polished steel 0.100 inch thick; the movable part or lower jaw is 0.200 inch thick

and of the same grade of steel. The operations in the order in which they are performed are shown in Fig. 1, *F* being the complete wrench.

The first operation was the blanking of the piece *A*. This was done with an ordinary blanking die and punch. The die, Fig. 2, had a stripper *A* and side guides *B*, these being fastened by screws *C* and dowels *D*. A hole was drilled in the face of the die for the stop-pin *E*, the end of this pin protruding a short distance above the face of the die, so that when the stock was passed through it would stop at the end of the last hole punched and be in position for the next blank. The plunger or punch, Fig. 3, instead of being made in one piece, was built up, the shank and bottom plate *F* being one piece, and the form or cutting part *G* being milled to fit the die and fastened to the top plate by screws and dowels, shown in Fig. 8.

The next operation, *B*, piercing the holes, was done by the die, Fig. 4, and punch, Fig. 5, this die being similar to the one just described, with the exception of the guides, stripper and stop-pins. The guides were placed at right angles to the hole in the die. The stripper was cut away, leaving a margin on each end, under which the blank was placed, a section *H* being left in the center as wide as the distance between the holes in the die would allow. The stop-pins *I I* extended to the top of the guides. The blank being placed under the stripper until the edge rested against the pin, the blank was then in the proper position for piercing the holes.

The next operation was bending the edges of *B*, Fig. 1, at the dotted lines to a right angle. This was done by the die and plunger, Fig. 6. The edges of the die were beveled and a recess was milled through the center the entire length of die. The width of this recess corresponded with the width of the blank, so that when the two edges were turned the blank would be straight from the jaw to the end. A stripper was made which the blank filled before the bending. The width of the plunger was .200 inch smaller than the die, to allow the thickness of stock on each side. The edges of the blank were just turned up and then faced on the side of an emery wheel, a rest being clamped the required distance from the wheel and parallel with the side. The blank was gently forced between the two and the edges were ground true with each other and parallel with the back, and when the blank was afterward closed together these two edges formed a tight joint.

The next operation consisted of another bending, which formed the blank as shown at *D*, Fig. 1, this work being accomplished by the die and plunger, Fig. 7. The die was milled out to the form shown at *L*. This also had the top corners well rounded. Two guides *M* were fastened to the face of die, the distance between these guides being the width of the blank after the preceding operation. The plunger was made in two parts, the shank and body *P* being one piece. The blade *Q* was fitted into the body by milling a slot the entire length of it, the blade being fastened by two set-screws. The recesses in the side of the blade allowed the edges already turned on the blank to enter, and on the up stroke it lifted the blank from the die and it was then slid off the end.

The final operation was closing the blank into the form of the wrench, as at *E*, Fig. 1. This was found to be the most difficult operation of all, as the blanks would not retain their form. After considerable experimenting with different tools and various methods, the die and plunger, Fig. 8, were adopted. This die was at first made a built-up die, but it was found to work loose, so a die was made from a solid piece. The top surface of the die was milled across the width of it, with the exception of the raise at *S*, the surplus stock being milled down to the

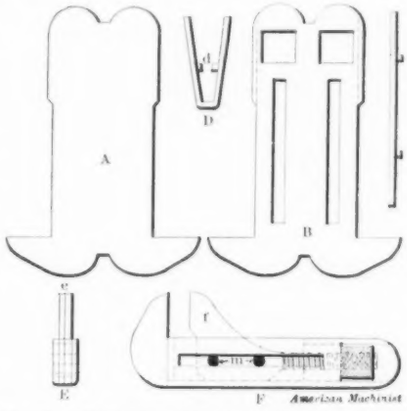
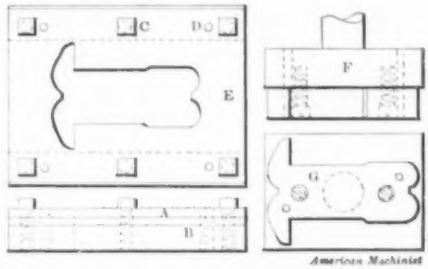


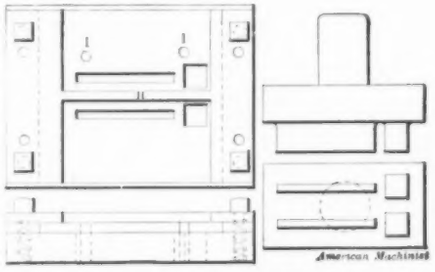
FIG. 1. THE DIFFERENT OPERATIONS IN MAKING A BICYCLE WRENCH.

face of the step *T* at opposite end. The center part was then milled .100 inch lower than *T*, the length between the steps at each end being the length of wrench minus the jaw. To be more precise, when the blank was placed on the top of the die for bending, with the small end resting against step *S*, the inside edge of the jaw part of the blank was parallel with the top of the bevel edge of step *T*. A slot *U* was milled in the center of the step, and slot *V* in the back. The arbor *X* was next finished, this being .202 inch thick, or .002 inch larger than the stock used in the sliding jaw, the width of this arbor filling the slot *U*. The length I will explain later. A small block *Y* was then made, fitting slot *U* as tightly as possible, and still being movable. This was then fastened on the top of the arbor, being left thick enough to prevent any twisting of the arbor during the operation. The block *W* was next fitted into slot *V*, this being fastened by dowels *Z*. The lever *a* was next finished, the end of it projecting beyond die about 12 inches. On the end there was driven an ordinary file handle, the opposite end being fastened to block *W* by pin *b*. A slot was cut in this lever directly in line with pin *c* in the arbor. This was to allow the pin *c* to move in the lever, as the arbor was being drawn out or pushed in, as the case might



FIGS. 2 AND 3. BLANKING DIE AND PUNCH.

be. The holes in the lever, the arbor and the lever connection were drilled, and the length of the arbor was determined in the following manner: When the arbor had been pushed in until the space between the beveled end of the arbor and the beveled edge of step *T* was .100 inch (or the thickness of the steel used in the wrench) the handle *a* would rest against the end of the die. The operation was performed by drawing the arbor back and placing a blank, bent ready for closing, on the face of the die, with the small end resting against edge of step *S*, the arbor being then pushed in until the lever rested against end of die, this giving the proper position of arbor. The plunger having been milled and set in the press to correspond with the die, and the press being set to the desired length of stroke, it is put in motion, and as the ram descends the plunger closes the wrench together, the two steps closing the jaw part tight, while the remaining part is closed on the arbor. This operation being completed, the lever is pulled out and the blank is taken off complete, ready for brazing. The parts that were brazed are marked *d* and *e* in Fig. 1. This part of the wrench was then



FIGS. 4 AND 5. DIE AND PUNCH FOR PERFORATING THE BLANK.

strapped on a strap buff until all the sharp corners were removed and the slots for the pins were filed, which completed this part of the wrench and left it ready to be nickeled.

The next work was that of finishing the lower or movable jaw *f*, Fig. 1. The first operation was the blanking. The die for

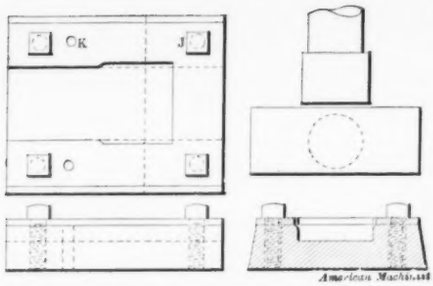


FIG. 6. DIE AND PLUNGER FOR FIRST BENDING OPERATION.

this, Fig. 9, was made as was the first die, except that this die, besides the blanking, pierced the holes for the pins. The width of the stock used fitted between the guides shown by the dotted lines. The holes were pierced in the succeeding blank at the same time a blank was being cut. The inside edge of the hole in the stock from which the last blank was cut was pushed forward until it rested against the stop-

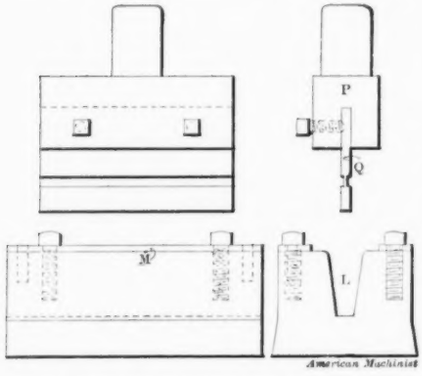


FIG. 7. DIE AND PLUNGER FOR SECOND BENDING OPERATION.

pin *g*. The stock was then in the proper position for the next blank to be cut. The plunger with the form of the blank and the shank to fit the press was made in one piece. The plunger was first fitted into the die, and while in its working position the holes for punches *h* were transferred from die to plunger. The holes were then drilled and set-screwed, and the punches were finished and fitted. Two holes *i* were then drilled in the blanking form on the plunger, in the exact position of the holes in the blank. Into these holes were fitted two pins *j* with their ends rounded. These served as

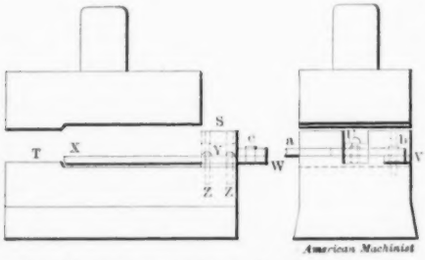


FIG. 8. FOR THE FINAL CLOSING OF THE WRENCH BODY.

guide-pins, and when the plunger descended to cut the blank, the pins would enter the holes already punched in the stock.

The next operation consisted of cutting the thread on the end *k*, Fig. 9. The thread is shown at *F*, Fig. 1. This work also was accomplished on the power press. The tools used were the plunger and die, Fig. 10. The die was milled on all sides, and the bevel milled to clamp into the die dish. The plunger was milled and the shank was turned. The two were then clamped together on the face-plate of a lathe, and the hole, half in the die and

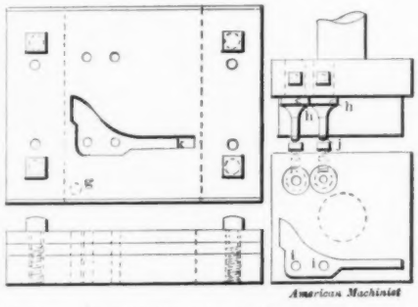


FIG. 9. BLANKING AND PERFORATING THE JAW.

half in the plunger, was bored and threaded. The tools then, being hardened, were placed in the press; the ram was adjusted until the thread was pressed to fit the nut, into which it worked. The blank was then strapped, as the large part of the wrench had been and it was ready to be nickeled.

The nut *A*, Fig. 10, was made on a screw machine, the outside being knurled for the finger grip. The pins *m*, Fig. 1, were cut and rounded, this work also be-

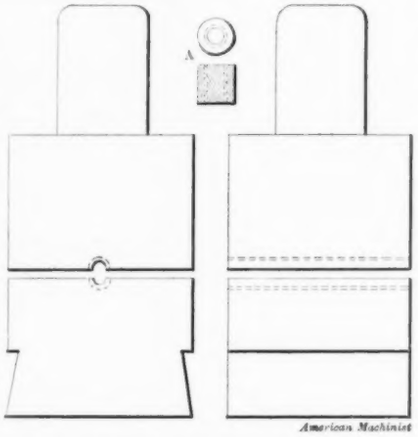


FIG. 10. UPPER AND LOWER DIES FOR THREADING WRENCH JAWS.

ing done in the screw machine; these pins as well as the nut being nickeled. The wrench was then ready for assembling. The number of wrenches produced was about twenty gross per day, and the work was, in nearly all the pieces, interchangeable. Occasionally a blank would be found where the slots for the pins were not exactly in line. This was overcome, when the slots were filed, by having a piece of steel made the exact size of the slot, with the bottom end tapered on the sides and ends, and when a blank was found in this condition, this piece of steel was driven through both sides, which left the slot straight. This had to be resorted to very seldom, as all the tools did their work well.

A Boring and Facing Jig.

BY JOSEPH V. WOODWORTH.

The casting shown in the sketch has six radiating cylinders, each with a cored hole through it. It was necessary to bore and finish the holes in line with the central hole *E*, and the opposite holes in line with each other, and the jig here shown was made for the job.

The center hole *E* was first bored and counterbored and the front faced at *D*. It was then driven on to an arbor and the back faced at *F*.

The jig consists of an angle casting with a boss on the face and back at *H* and *I* respectively, and also a back extension on the top. After being planed on the bottom and dovetailed for the bushing plate *K*, bosses *H* and *L* were faced and the top was planed and dovetailed for the upper bushing plate *J*. It was also dovetailed on the side for the index pin bracket *W*, and the hole was bored for the clamping stud *O*.

The two bushing plates *K* and *J*, of machine steel, were fitted tightly into the dove-tailed channels, located in line with each other and fastened. The centers of the holes for the bushings *U* and *V* were located by setting the casting on its side on a surface plate and striking a line from the center of the hole for the stud *O* to the plates *J* and *K*, with the help of a Brown & Sharpe hight gage. The center in the opposite direction, the distance from the face of the boss *H* to the center of the bushings *U* and *V*, was also marked. The plates *J* and *K* were then driven out and the holes were bored and the two bushings *U* and *V* were driven in. The plates were then returned to their respective positions.

The index plate *N* and clamping stud *O* are in one piece. It was a mild-steel forging. The plate had on its periphery six equidistant square notches. The index pin bracket *W*, a casting, was then fitted to drive tightly into the dovetail channel in the side of the angle plate. The hole for the pin *X* was then bored.

The pin was made of tool steel, the end fitting the square notches in the index plate, and slightly rounded to enter the notches easily. A stiff helical spring *V* was made and also a hole was drilled in the pin *X* for the spring cross-pin. After the handle *Z* was made all the parts were assembled.

All that remained to complete the rig was the boring bar and the two sets of cutters *B B* and *D*. This bar was of machine steel, turned taper at the end to fit the drill spress spindle, and for the rest

of the length a running fit in the bushings *U* and *V*. The bar was small enough to clear the cored holes. Two sets of cutters were made, one set for roughing and the other for finishing. These cutters were fastened in the bar by taper keys. The two cutters *D* were long enough to face the ends of the cylinders as they were bored. The jig was strapped to the table of the large drill press. The index plate *N*, with the pin *X* in one of the notches, was clamped and a casting to be bored clamped in position on it, so that the boring bar would be as nearly central as possible in the cylinder to be bored. The roughing cutters were then fastened in the bar and the holes were bored. These cutters were then removed and the finishing pair were substituted when the holes were finished.

After all six holes were bored, which required only three adjustments of the index plate, both ends of all six cylinders were faced by using the cutters *D*. All the castings, of which there were a large number, were bored and faced in this manner, and were found, when assembled with other parts, to interchange perfectly.

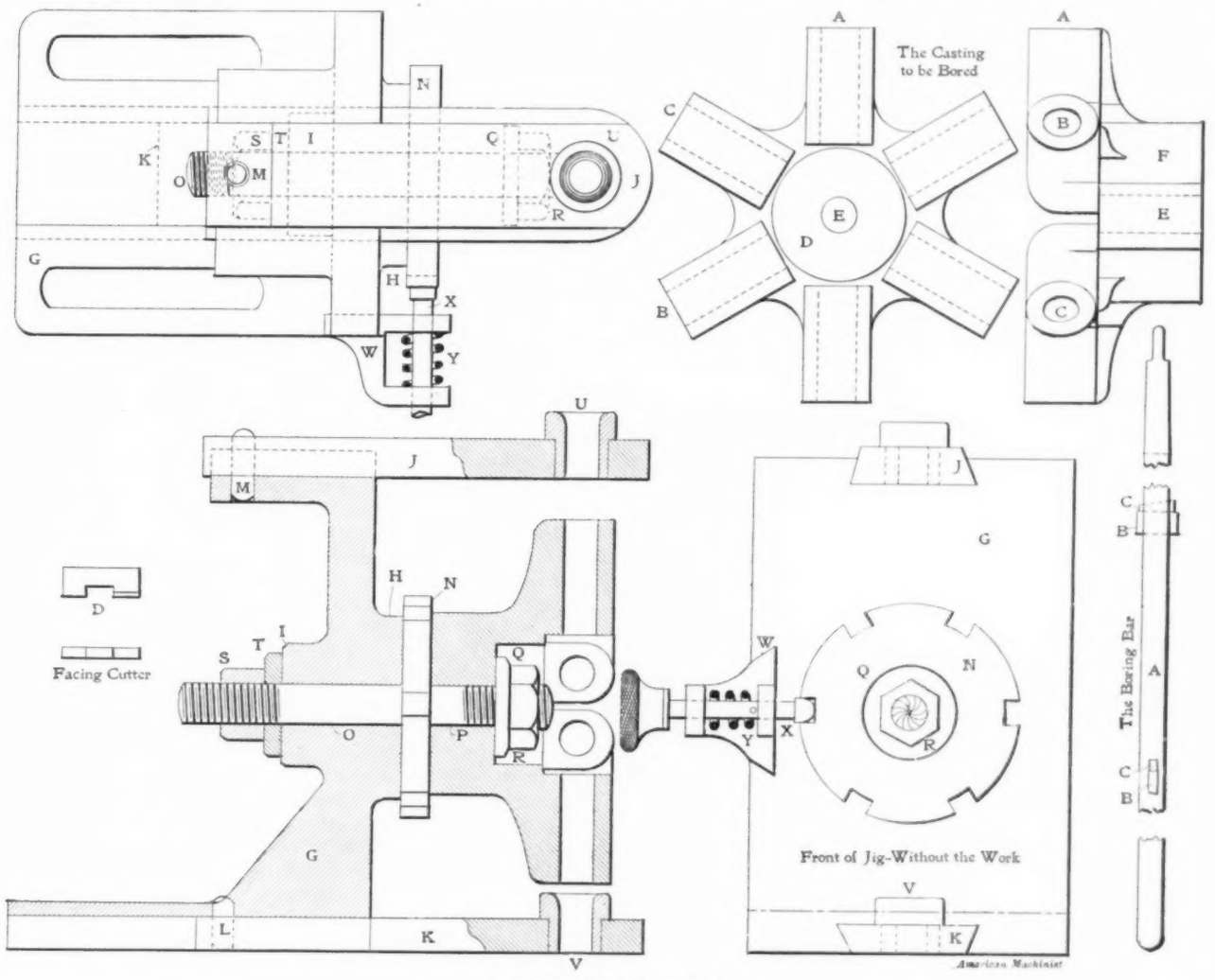
Adaptation to Discovery.

BY JAMES WILSON.

No elaborate device was at first used to show the possibility of obtaining mechanical from electric action. Through the gateway of what had already been achieved by investigation in the domain of magnetism and electricity Oersted, in 1819, was able to show the possibility of converting the energy of an electric current into mechanical power. In his experiments, which show, by the way, that the greatest discoveries in the interests of mankind are not always made by one man or at one time, he demonstrated as far as he then could the likelihood of this result.

By means of needle and wire and with the aid of no unusual device or operation but that of preparing a pivot around which the needle was free to move, he succeeded in showing that through the electric current in the wire the needle was rendered susceptible to motion, and that electricity and magnetism are "two forces which act upon each other, not in straight lines, as all other known forces do, but in a rectangular direction." Here, then, was a basis, so to speak, from which he or those who were to come after him could start for future investigation, in what promised to be one of the most interesting and fruitful fields of attainment the world has ever known. The possibilities of his discovery were wonderful indeed. If the promises it seemed to offer were realized, it would afford opportunities for research and mechanical skill in various related branches of applied science; it would especially revolutionize the entire system of transmission by belting, and usher in the dawn of a new day for speedier and more economical methods than hitherto.

Very small at first were the indications of such a harvest as that which we now possess from Oersted's efforts in the line I refer to. They are not even an attainment in the most meagre result of mechanical power. Everything which his discovery exhibited was but a turning of the magnetic compass needle through a few degrees of the circle. *It merely showed that mechanical motion could be obtained to a very limited extent through the fitting and conjoint play of electricity and magnetism.* In his time the electromotive force which he thus obtained could not have been more than one or two volts



A BORING AND FACING JIG.

at the most, and the area over which the needle slowly but surely moved when the wire was not shifted for experimental purposes more than 40 or 50 degrees of a revolution, and yet, for one thing, this comparatively small result in strength and extent of motion was more than sufficient. *It indicated plainly and undeniably that mechanical motion was possible under certain appropriate relations and adjustments of the two great forces of magnetism and electricity,* and it also foreshadowed the day when through the attending development of mechanical skill this small beginning in the way of transforming the energy of electricity into the energy of useful motion would be an accomplished fact. Oersted made it apparent that nothing stood in the way of having such energy transformed into available mechanical force, but the lack of knowledge. He showed in fine, in an inceptive fashion, that mechanical motion was capable of being originated and developed to an unlimited extent in the course of time.

Nor in judging of the apparently small result he attained must we forget the difficulties attending the birth of new ideas and the vigilance necessary in observing the faintest results of experiment. "Many of the most brilliant discoveries may be traced back," says Siemens, "to the mechanical art of measuring." Here, if in any case, precision is necessary, and here, if anywhere, is unfolded the distinguishing mark of the true philosopher and man of research.

Oersted's discovery made it plain that through a few degrees of the circle the mechanical motion of a needle was possible. It was left to Faraday, in 1821, to show that a wire carrying an electric current could be made to complete the entire revolution and *vice versa*—the entire revolution of a magnet around a wire, and thus to inaugurate the era of motors and generators.

Here, too, as in Oersted's time, the great discovery of Faraday was made with very little display of mechanical apparatus. His device for thus developing the potentiality of Oersted's achievement was of the crudest character possible. And this, we think, may be accounted for, not only from the antipathy which Faraday had for work that appeared to him to go beyond his own more subtle sphere of mental action, but also from what is natural under all such conditions of investigation—viz., that between a discovery and the purposes to which such a discovery may afterward be put—there is generally a more pressing call and necessity for thought rather than for mechanical skill. This, I think, accounts for the small attention bestowed on the mechanical side of those discoveries, both by Oersted and Faraday, and which afterward gave such unlimited scope to those whose task it was to watch the gradual development of electro-magnetism, telegraphy, electrolysis, and the electric light, etc., and furnish machinery for the grandest attainments of these.

Thus, in 1831, when Faraday succeeded in establishing the fundamental fact of magneto-electricity—viz., that the motion of a magnet near a coil induced a current in it which was inverse or direct according as the motion was one of approach or withdrawal—he was content to leave the application of this fact to others whose work more than his lay rather in constructive than in experimental science.

It was not Faraday, therefore, but Pixii, who in 1832 constructed a machine that first best illustrated the fundamental fact of magneto-electricity. And for this reason, on the mechanical side at least, the apparatus of Pixii possesses great interest. The construction of this tool should be studied, not only, I think, because it was the first actually completed and perfected tool of its kind so far, but also because it really and essentially *and more simply than in any other case,* explains the action of all other motors and generators since made, and that in spite, too, of the coeval and correlative advance in the knowledge of principles that has marked the progress of our time.

Compressing Air by Gas Explosion.

An air compressor without a piston or any moving parts except valves has lately been described in the "Revue Universelle des Mines et de la Metallurgie." It is the invention of M. Emile Gobbe, and has been tried with some success at the Monceau Company's blast furnace. The principal feature of the arrangement is an explosion chamber, the outlet of which leads to a chimney. A throttled valve which tends to remain open by its own weight is introduced between the chimney and the explosion chamber. Two conduits, one for gas and the other for air, lead to this chamber. At some distance from the points at which they enter the combustion chamber, each conduit is provided with an inlet and an outlet valve, the latter communicating respectively with the receivers for compressed air and compressed gas. A draught having in any suitable way been started up the chimney of the plant, charges of air and gas are drawn in and mix in the combustion chamber. The mixture is then fired by an electric spark. The explosion closes the valve to the chimney and forces a portion of the air and gas back along their respective conduit pipes and through the discharge valves into their receivers. When the pressure falls sufficiently, the valve at the base of the chimney opens automatically again, and a fresh charge is drawn in and the action is repeated as before. In the experimental plant erected at Monceau, the explosions followed each other at the rate of twelve to fourteen per minute; but the plant proved to be in need of considerable modifications if satisfactory working was to be obtained. In a laboratory apparatus since constructed and designed to work with town in place of blast-furnace gas, good results have been obtained in the matter of regularity of working, and the inventor claims that with a large plant carefully designed very considerable economy could be relied on, and the capital cost would be extremely small.

Replies to Requests for Catalogs Etc.

A machine-tool manufacturer was discussing the other day the practice followed in some houses of attempting to judge of the character of inquiries for catalogs, circulars, etc., received, and of refusing to send catalogs or to reply to those which seemed of a character not likely to result in business. He declared it to be his conviction that this practice was a great mistake and said that he had known of cases where a workman, perhaps a foreman or a leading mechanic, had seen a description of a tool, perhaps in the reading or advertising pages of the "American Machinist," had seen that such a tool would be very useful and economical in the work done in his shop, but knowing that it would be very difficult to interest the proprietor in such a tool, or in fact in any new tool, this workman or foreman would first send an inquiry, perhaps badly written on a postal card, somewhat soiled with shop dirt or oil, such a man not usually having access to the office stationery.

The idea in such a case probably is to get a full description of the tool, perhaps a photograph or a circular setting forth its advantages fully, and when it is received it is laid aside until the occasion arises when a job is in the shop demanding such a tool; the workman perhaps knowing full well that at any other time it would be impracticable to interest his employer in anything new. Such an occasion may not arise for several months, but when it does our man is ready with his material and calls the attention of the manufacturer to the fact that "they are up against it," so to speak, on this job, but that with such and such a tool it could be done readily and easily. If the proprietor seemed in the humor for it he then shows him this circular or description and perhaps readily convinces him that it would pay to have such a tool in the shop.

The speaker said he had known cases to work out in that way and that sales were often made as the result of just such a procedure. He was convinced on this account and for other reasons that wherever anyone whomsoever had shown sufficient interest in his machines to send him any kind of a request for full information about them it always paid to reply to that inquiry in some form or other, either to ask the man for fuller particulars as to what he wanted or to send the catalog or circular asked for. Another point he thought was that where

this was refused or where the man got no reply to his inquiry he not only failed to develop interest in the machine, but he was apt to be offended because his inquiry received no attention, and to be opposed to the tool rather than in favor of it if anything else could be substituted for it.

Hobbing Worm Wheels in a Lathe.

The accompanying illustrations show an arrangement for hobbing worm wheels in a lathe. Fig. 1 shows a sectional elevation of the rig and Fig. 2 the arrangement in position on the lathe with the work in progress.

In a certain line of machines which we build a worm wheel plays an important part. These wheels are steel castings and have 30 teeth 2-inch pitch. The rough castings gave us so much trouble, owing to the lumps and inequalities on the teeth and to their being out in pitch and diameter, that we decided to have them all hobbed for the future. Having no worm wheel cutting machine we decided on doing this job on a lathe and adopted the arrangement shown.

From the saddle of the lathe we removed the slide rest, leaving the base of the rest in position on the saddle and to this base was fitted the casting *A*, Fig. 1, the bottom being let into the circular groove on face of base, the casting being secured by the bolts intended for securing the slide rest. *A* was made with two brackets to receive a worm with its spindle *E* which engaged with a worm wheel *B*. The boss on *B* formed a bearing, rotating within *A* and held in position by a circular gib *C*.

C was put in in four pieces and was adjusted by eight screws, the screws being got at through holes *D* in top of worm wheel *B*. *B* then formed a rotary table, to which the worm wheels to be hobbed were clamped. The hob was rotated on the lathe centers and table *B* was revolved at the proper speed by means of the ordinary change wheels, suitable wheels being selected to give the required ratio of speed and coupled to the worm spindle *E* by means of the telescopic universal joints shown in Fig. 1.

The arrangement shown has done us good service in truing up the rough teeth in these steel castings, the worm wheel shown in Fig. 1 being one of sixty. With this arrangement we have also cut several worm wheels with phosphor bronze rims of the size shown in Fig. 1 with satisfactory results. While recognizing the fact that such an arrangement would never do for work in which great accuracy was required, still this description may be of interest to some of your readers as showing what we have found useful for jobs like those described above.

Fig. 3 shows in detail the hob we made for truing up these cast-steel wheels. It was made with inserted teeth, the teeth being pieces sawn from an 1½x1½-inch bar of Hecla tool steel. The only point of interest is the method of fixing the teeth. The hob body was of mild steel and was first spaced off as instructed in the illustration. The ⅜-inch holes for fixing pins were drilled from top of thread right through into space between the threads on the other side of hob, the center line of hole passing through the center line of hob. After that the spaces for teeth were shaped just opening out the edges of the ⅜-inch hole and with the line of the cutting edge passing through the center of hob. It will be seen from the section that the edges of the teeth being not parallel to the sides of the fixing pins produce tapered flats on the pins when they are fitted in, and that the pins when driven in securely fasten the teeth in the space. To prevent side movement we further secured the teeth by the 3-16 inch steady pins shown, the holes being

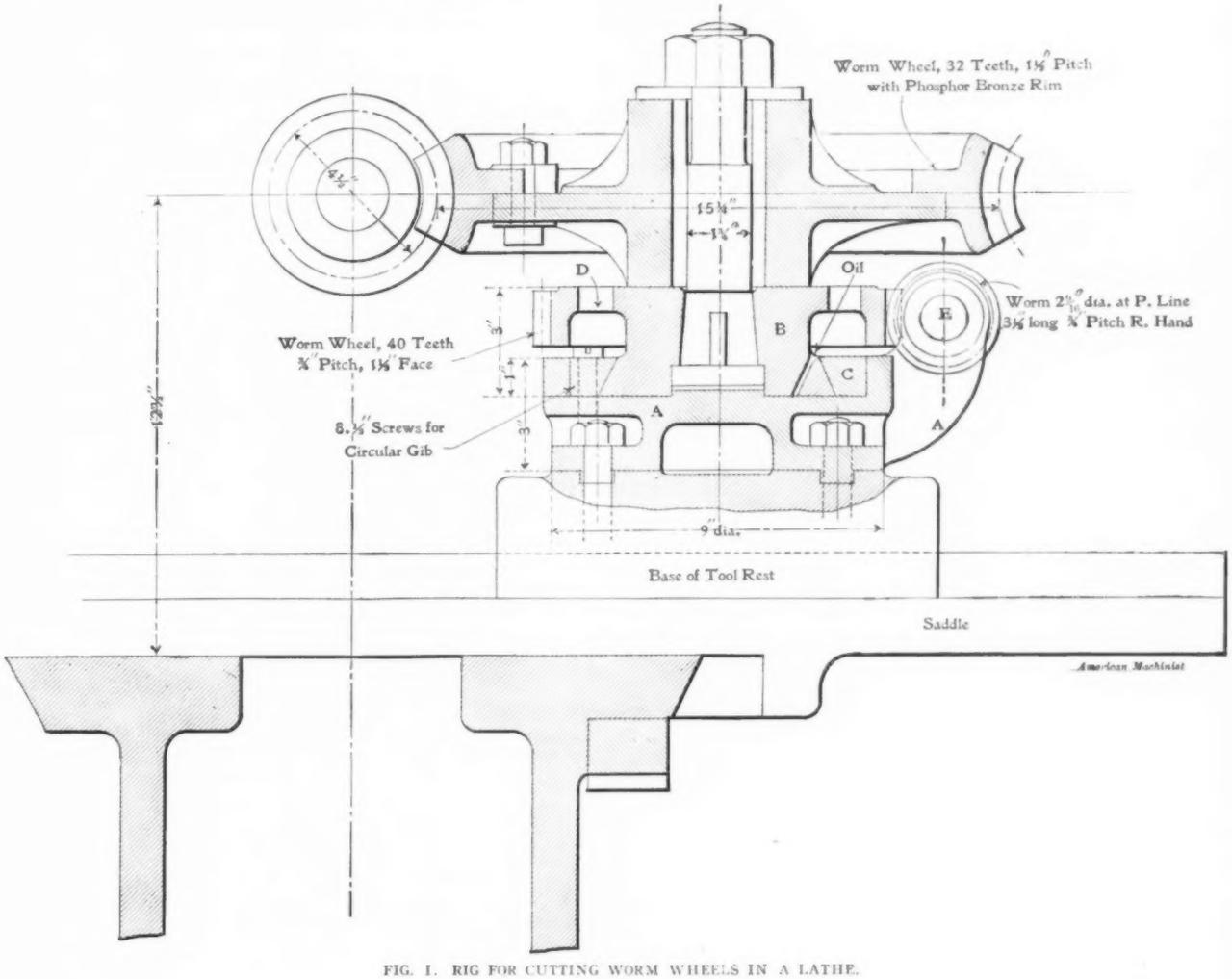


FIG. 1. RIG FOR CUTTING WORM WHEELS IN A LATHE.

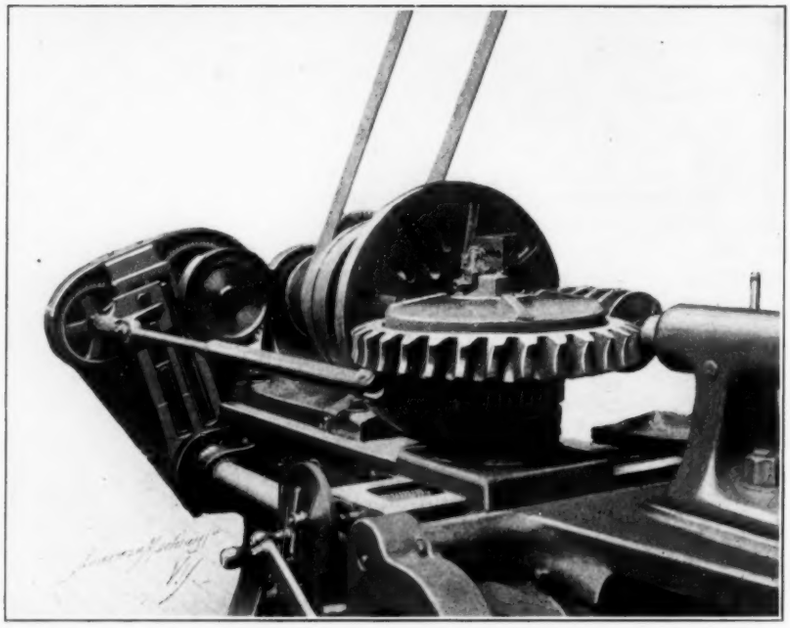


FIG. 2. THE HOBBING RIG AT WORK.

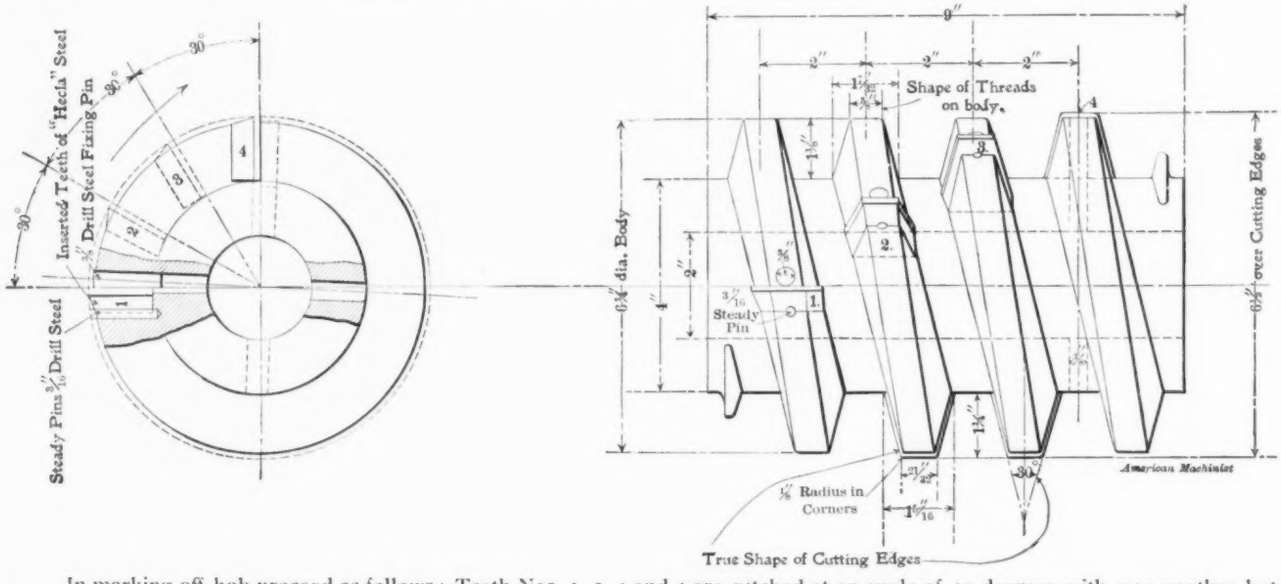
drilled half in the teeth and half in the body.

After all the teeth were fitted in the hob was put in the lathe and the teeth turned up to the proper shape. They were then taken out, relieved on top and sides on the milling machine, finished off, hardened and tempered and re-inserted ready for use. The ⅜-inch holes for fixing pins being drilled through and through, makes it a very simple matter to remove a tooth. A piece of ¼ or 5-16 inch round steel is inserted in the hole in the space between the teeth and the fixing pin is driven out. The bottom edges of the teeth project sufficiently far into the ⅜-inch hole to enable the tooth to be driven out by the same means. We experienced no trouble whatever with teeth coming loose, and could always replace a damaged tooth with very little trouble. C. P. T.

Warrington, England.

Emery-Coated Tools.

The use of emery tools has been limited because the material does not lend itself readily to shaping; we are practically confined to grinding surfaces of simple forms. The galvanic process invented by Joseph Rieder, of Leipzig, however, allows us to make use of any kind of emery powder, and to arrange it in various shapes, so that we are presented with a new style of emery tool. Rieder is known as the inventor of the electro-engraving process, whose characteristic feature is a machine which returns the plaster negative to its position with mathematical accuracy, so that the galvanic etching, which has to be interrupted several times a minute to secure uniform electrolytic action, practically remains continuous. In order to fix the emery sand on the tools referred to above, he first coats the emery with a varnish obtained by dissolving wax or paraffin in benzine. Graphite will adhere to the grains when they have been treated thus, and in this way the emery surface is made electrically conductive. The tool, *e. g.*, a disk, is placed in the sulphate of copper bath, and the prepared sand dropped on it. Each grain will become embedded in a coating of copper, and the grains will thus be fixed just as gems have been mounted for some time by means of a galvanoplastic process. The sand can also be treated with a glycerine paste, which is then applied to the surface to be covered with emery. As soon as a thin film of copper has settled on the steel, the glycerine is washed off with hot water, and the copper film is afterwards thickened in the bath. In this way emery tools are obtained, which are said to wear very well. Their disadvantage is that they do not cut deeply, because the interstices are filled up. But such disks can be revolved at a much higher rate than we could venture to adopt in the case of an ordinary emery wheel of the same dimensions. Another advantage is that we can construct tools of this kind in almost any shape—hollow drums, cutters of various profiles, reamers, convex or concave lenses, knives, engraving tools, and even files. When the electrolytic file-



In marking off hob proceed as follows: Teeth Nos. 1, 2, 3 and 4 are pitched at an angle of 30 degrees with one another but are fixed on each succeeding thread, as shown. Between 1 and 2, 2 and 3 and 3 and 4 space off on circumference of helix 6 equal divisions or 5 more teeth. The ⅜ inch holes for fixing pins must then be drilled, the center lines of holes passing through center line of hob. The spaces for teeth are then shaped out, the cutting edges in all cases to be on a line drawn through center of hob and just opening out the edge of ⅜ inch hole on top of thread. Teeth to be fitted with $\frac{3}{16}$ inch steady pins and relieved down to threads on hob body.

FIG. 3. INSERTED TOOTH HOB.

sharpening process came up about ten years ago, the invention was ascribed to and claimed by several inventors. In that case the file is the anode. Here we have a kathodic process which may also have occurred to several scientists, though we are not aware that anybody but Rieder has put emery-coated tools on the market.—"Engineering."

Letters from Practical Men

The New Method of Developing Photographic Plates.

Editor American Machinist:

As a mechanic I have yours and some other mechanical papers, and as an amateur photographer I have some regular visitors at my house in the shape of photographic journals, and I am always interested doubly in anything photographic and mechanical both, but I want to add a line to straighten out an impression made by F. O. Tografer, page 1007, No. 36. In the first place, a plate may be over-exposed almost indefinitely and yet get a picture, but professionals as well as experienced amateurs say that a plate more than a little under-exposed is of no use only as it might be over-exposed on another subject and developed accordingly. I would say that Mr. Tografer gives an old way of developing over-exposures as a new way, and he only mentions Ortol. Now, a common practice with photographers is that whatever the developer may be, Ortol, Metol, Pyro, Tolidol, or any of the list of developing agents, to prepare the bath the same as for normal exposures, only leaving out the carbonate of soda, which is the accelerator, have the carbonate of soda dissolved in an ounce or less of water, put a small fraction of it into the developing bath, and then put in the plate; if in a short time the image does not appear, take up the plate and add a little more of the accelerator; repeat this until enough of the accelerator has been added to bring up the image strong in detail. Then, to give the plate density for good printing qualities, either put in all of the accelerator which the formula calls for, or put the plate into another full strength developing bath; but care must be taken in this not to over-develop the plate. Then place in the hypo and fix it as usual.

I would like to say also a word about exposures. From my experience and what I have learned from others, the best half-tones, especially of machinery, are made by stopping down the diaphragm, and, if anything, over-exposing the plate. Then develop for sharp detail and what is ordinarily called a hard negative, and then, one step farther back, an anastigmat lens is the best lens.

Some months ago, I think, Tecumseh Swift was writing about what he would do when he became a millionaire. I once worked for the National Cash Register Company, so I feel like making a suggestion for him or any others with a like worry: Start early and get a camera and go at it hard, and you will never get your million, I am sure, for a camera carried by a man of time, means and a desire for pictures will lead him through the fields of photographing in colors (big money), photographing things with the microscope (big money), expensive lenses and more and bigger cameras (more money), stereopticon to show his pictures (money), long journeys after pictures (expensive), and, lastly, an invention of his own and a company formed to manufacture—fail-use, money all gone, *finis*.

BENJ. D. CHAMBERLIN.

Rochester, N. Y.

The Card Index Again.

Editor American Machinist:

A great deal has been said now and again regarding the card index and its usefulness in various ways. I note that one person at least says that instead of referring to the index to find where a certain piece of information can be found (as was the case when the card-index system was first started), we now refer to the index for this very information itself.

Some time ago I purchased one of the Fred Macy Company's trial card indexes for $1.25, and since then have been filing a great deal of information in the way of notes, formulas, etc.

I have frequently seen tables, diagrams, formulas, and in fact complete articles in the "American Machinist" and other technical papers, which I have thought I would like to preserve and have handy and not be obliged to refer back three or four volumes, and the idea occurred to me that if I could photograph these down to the size of a 3x5-inch card I would file them in my index.

So when I noticed Mr. Tucker's article on "Standard Machine Handles" and also the article on "New Method of Developing Photographic Plates," by F. O. Tografer, I thought these were two articles that I should like to refer to again, and I decided to try the experiment.

I send you herewith a blueprint and a velox print from the negative, and as I exposed only one plate I leave you to judge of the result. I used a plate called "Corbutt's Keystone B," which I use for taking machinery. I find these plates work very nicely for this class of work, as they are slower than most plates and there is less danger of over-exposure. This plate was exposed 4 minutes and 10 seconds in a very well-lighted drafting room on a sunshiny day.

This picture was taken with a 5x7 camera with a single achromatic lens, and I found that I was unable to get a focus with the lens on the back combination as regularly used, so I took the lens out and placed it on the front combination and this little difference made it just possible to get a focus.

It will be noted that although I used a 5x7 plate the picture is only about 3x4½, and this is because the page of the "American Machinist" was so small that the camera could not take a larger reduction.

It will be noticed that the blueprint is practically as clear as the velox print, the only poor places in either being a few of the figures on the diagram, and if the "American Machinist" could bear this point in mind and use larger type it will certainly be a great success.

I hope that the idea, although not new, may be of benefit to others of your readers. I know of no easier, quicker or handier way of filing information than this.

H. D. VAN DOORN.

[Both the prints enclosed by Mr. Van Doorn are quite legible, and it is evident from them that articles, diagrams, etc., appearing in this journal can be filed in this manner and be readily available. We think, however, that the files of that paper itself are best, supplemented perhaps by a card index of those things that are of special interest or value to the user. The cost in time and money of the method given by Mr. Van Doorn must be considerable, while the one we recommend costs almost nothing.—Ed.]

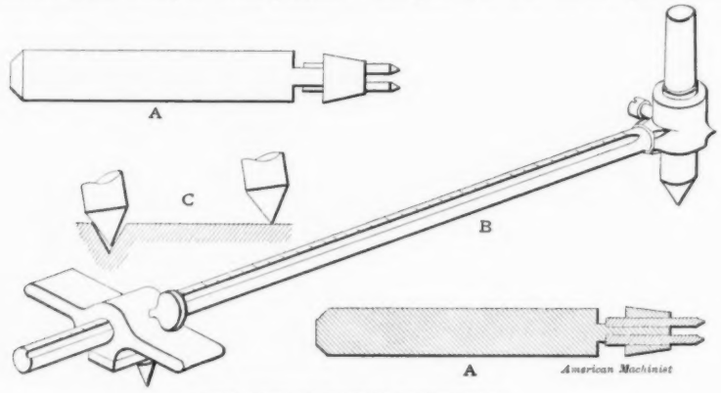
Two Center Punch Patents.

Editor American Machinist:

A couple of United States patents relating to center punches have recently issued, and as they have interested me it is possible that they might interest some other fellows in the shop. I have put the drawings together so that the essential features of both inventions may be seen in a single cut. They are designated *A* and *B* respectively. The punch *A* is for making successively, and of course spacing accurately, any number of centers at small but constant distances from each other, as, for instance, an eighth of an inch, which the inventor suggests as a typical distance. It is easy enough to make this twin center punch if you follow the inventor's directions. The main piece or stock should be "preferably of metal." You drill the two holes the right distance apart and cut out the notches on the side. You then get out the little center punches to fit the holes, and to make them hold in the holes you can bend them a little before you drive them in. That's a kind of a compound micrometer way of making a fit that is not included in the claim, although it is in the specification. There are, however, nine claims to the patent, and I don't know but that the patent attorney used more ingenuity than the inventor. You stand the punch upright upon the work and in the right place and when you strike it with the hammer you have two centers on the work the same distance apart as the center points are, and it is to be supposed that they

are all right. But when it comes to working the third hole it will be like my sketch at *C*, and the distance can't be the same as for the first two centers and I don't see how the thing can be made to work right at all.

The device marked *B* might work all right for the longer distances to which it is adapted, although the jarring would be apt to slacken the thumb-screw and allow the gage point to move. The principal thing, however, about these two devices is as to what there is of novelty of invention about them, or what possibility there can be of ever realizing anything from the patent. Supposing them to be much more valuable than they seem to be, who would want to buy the right, or who would hesitate about using the ideas embodied in the devices without asking anybody's permission? MORRIS FULTON.



TWO CENTER PUNCH INVENTIONS.

Strike Notes.

Editor American Machinist:

I have been "scabbing" it for the past few weeks, and have found out a number of things that I didn't know before. Although I thought I knew them I know them better now.

First, I thought that the Hendey-Norton people made good lathes—in fact, I was sure of it—and that the Brown & Sharpe people made good milling machines, but when I got to "scabbing" it in good shape and ran both of these tools (not at the same time) I found out that they were far better than I thought—in fact, it was a pleasure to operate them. I don't mean that I would like to run one ten hours for nine hours' pay, but if I had to work ten hours a day I would ask the boss to give me a Hendey-Norton lathe to work on. It is a poem in comparison with the old chain lathe that I served my time on, with the hand wheel way up to the headstock and a cross-feed that would cut only 4 inches and then had to be reset and started again.

I do not like to be called a "scab," but there seemed to be no other way. I had nothing to strike for. I was working ten hours and sometimes more, but I don't know as the boss would have said anything if I had worked nine hours, but I could not sit around and see a lot of work waiting to be done and not take hold and do what I could of it.

But to get back to the lathe again: I had a large screw to cut, and it would have done the boys good to see me try to reverse the lathe, only to find out that both belts on the countershaft run the same way, only one was at higher speed, and it didn't reverse worth a cent. Also to see me try to pull out the pin on the headstock that the small intermediate gear runs on, when I should have just slipped the gear out and let the pin remain.

The Brown & Sharpe miller gave me no trouble. They do not put a drift-pin hole in the spindle, and I guess it doesn't need it, but I did hunt all around for the book to explain how to put the worm into gear in the dividing head, but I worried it out without the book.

I slipped up again when I attempted to remove the chuck from the Hendey-Norton lathe. I started it off one or two turns by hand, and then tried to use the backing (?) belt, and ran the chuck on so hard that it took me and the boy with a big bar to start it off again. The cub did not say anything, but I fear he has not so good an opinion of the boss as he had.

We had some forty men employed and thirty-eight of them went out, and it gave the room that tired feeling one reads about; and then the men that came in and worked, or rather tried to work, made the rest of us tired. When a man asks you, "What shall I do to make the machine cut down?" you feel like telling him to go and serve a few years and learn what to do in the case.

The boys outside the gate have a hard time, I know, but it is hard inside also, if they but knew it. I never knew until I got into the mess that there was such a thing as a "professional scab"—that is, a man who makes it his business to go and scab every time he hears of a strike in his line of work. I don't think it will be best to put my opinion of that kind of a man on paper; it wouldn't look well in print.

But to get back into the shop: We had a new Barnes drill with all the latest improvements, and I had the pleasure (and it was a pleasure) of drilling out a die on it, and when I thought of the old post drill with a square socket that I used to fit the drill into hot and then start up the drill and spring it true and make a prick punch mark so as to know how to put it in next time, I felt glad I was living even if I did have to work ten hours a day. Seriously, though, I am glad the boys are getting their nine hours, and I don't believe there is a foreman who reads this paper but what is glad, too, although it will not always do to say so. "SCAB."

The Water Anneal—The Whiskey Problem.

Editor American Machinist:

Some years ago there was a series of articles in the "American Machinist" upon blacksmithing and the handling of steel, written, I think, by B. F. Spalding. They were very interesting, as they were evidently written by one who knew what he was writing about. He spoke in particular of the "critical point" in the heating of steel or the temperature at which, or beyond which, the steel would harden when dipped in water. He stated that in the common process of annealing steel by heating it beyond this "critical point" and then transferring from the fire to some cooler material such as sawdust or lime, it received a chill which had the effect of hardening it to a certain degree which any further slow cooling did not remove. This fully agreed with my experience, although up to that time I had not realized where the trouble lay. Since then I have always left the steel in the fire until it cooled to a dull red, after which time I could plunge it into water at once if in a hurry for the piece. This has never failed to produce a good-working steel.

Morris Fulton might have solved the "whiskey problem," page 1003, by the following process, and saved still more stationery and time:

$$.9375^{16} = \log. \quad .9375 \times 16 = T.97197 \times 16 = T.55152 = \log., .356051.$$

I think this is a little nearer correct than his result. Would that all whiskey problems might be solved as easily. H.

The Side Play of the Caliper.

Editor American Machinist:

Despite heat and other things the "American Machinist" continues to provoke thought. One subject on which it has caused several to do some thinking is "The Inclination of the Calipers." The ideas brought out during the last eight months are well worth absorption, and to me it seems that there is still a point or two to cover.

Most mechanics will avoid this device of measurement as far as possible; some will say they never needed anything of the kind, and suggest that much of it may be easier and better done some other way.

Now, taking the case which Mr. Fulton works out and tabulates for us, where the hole is of a known size and the gage is an unknown small amount less, it would seem that this might in almost all cases be easier and better done by inserting thin flexible sheets of known thickness between the gage and the work. Of course there *might* be a case where a workman had no "mike" and could not measure his packing. Taking the second case, of the gage of known length shorter than the unknown bore diameter, and Mr. Vernon's approximate rule seems like a very handy way out; but it is an approximation and open to suspicion on that account; and again, the packing method will tell the difference between gage and hole probably more to the liking of the average machinist than "figgers."

For the third case, a hole of known size and a gage of unknown length, longer than the diameter of hole, Mr. Fulton's slow but sure—if you are careful—square-root method will serve. We will take, say, a hole 10 inches diameter and a gage inclined 1 inch from the perpendicular when inserted in the hole and made to touch at each end in an attempt to place it square across the bore, as in Fig. 1. It will readily be seen that the gage length is the square root of $10^2 + 1^2$ or 101, which is 10.0499. Also, if you consider the gage in this case as the secant of an angle, radius 10, you get the same 10.0499 by dividing radius by cosine; but this requires careful work and a better table of sines and tangents than most of us have at hand. Mr. Vernon, or any other qualified person, could do us all a favor by sending an easier method.

The fourth case, of the gage of known length longer than the diameter of a hole of unknown size, may be illustrated by the same figure. We will call our gage 10 inches, and consider it the radius of an angle (am I inventing a term?), sine 1 inch, and by referring to a table of trigonometrical functions we see that cosine $A\,C$ is 9.9499, which it will readily be seen is the square root of 10^2 minus $1^2 = 99. = 9.9499$.

This still leaves for our consideration four classes that have not yet been touched upon by the recent writers for the "American Machinist." No 5 is an outside gage of known capacity and a solid of unknown diameter slightly less than the gage size. It will readily be seen that this is a repetition of the conditions of No. 4, except that it is outside instead of inside. The insertion of packing of known thickness is here quite possible, and would be the usual method. No. 6 is the case of an outside gage of unknown capacity used on a solid of known diameter and less than the gage size. Here the solid and added sheets of known thickness serve very well to measure the gage of unknown size. This is a duplicate of No. 3 except being outside instead of inside, and the packing can very well be used.

No. 7 is an outside gage of known measure to be used on a solid of unknown diameter and slightly larger than the gage size. All will see that this is only applicable to dimensions above the sizes of yoke micrometers and to circular work, as in Fig. 2. Mr. Vernon's approximate rule will solve this within narrow limits; or it may be gotten at by finding base $B\,C$ of triangle $D\,C\,B$; and, by proportion (as these are similar triangles), the altitude of $A\,C\,D$. The only solution by angles that occurs to me just now is much longer, so will not be given. But it is plain that packing could not be used in this case.

An outside gage of unknown capacity slightly less than a solid of known diameter we will call No. 8. From the foregoing it will be seen that Mr. Fulton's method can be used here. We might here use the rule for finding the length of the chord $A\,D$, consider that a sine and from it find the cosine $D\,B$. (The chord $D\,E$ being known, the rule for finding the chord of half the arc, $D\,A$, would apply, but includes too many "figgers" and takes too long.) It will be seen that in cases Nos. 7 and 8 the gage is sprung over the

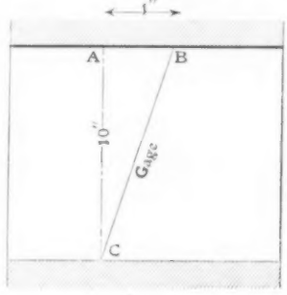


Fig. 1

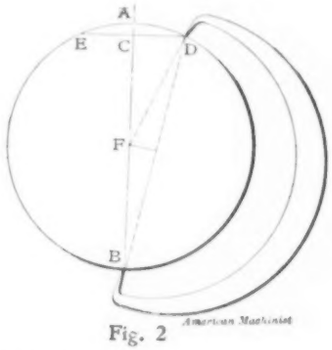


Fig. 2

THE SIDE PLAY OF THE CALIPERS.

work and chord $D\,E$ is measured as extending from end to end of the drag of the gage on the work. While quite accurate results may be obtained by the use of a table of sines and tangents carried to minutes—if you stop to estimate seconds where the table does not happen to have just what you want—I am free to confess it includes more in the way of figures than suits me, and must be carefully done.

Anyone who has worked in a machine shop long has "been up against" one or all of these cases one or more times. It chanced some time ago that No. 7 was before me in the shape of a wheel that should allow a 30-inch gage to pass over with a touch, but was taken out of the machine while the gage would still drag—we will say 2 inches, to make it convenient. By some that had to do with the work it was thought it would pass; by others different thoughts were entertained. The thing to do was to measure it with the only gage at hand, the gage that was smaller than the work. When it had been figured out as closely as time and convenience would allow, the work was passed and all parties were satisfied. By the three methods mentioned I have in this case these three results:

Trigonometry	30.01668
Square root and proportion	30.0166798
Vernon's approximation	30.0170666

By some it was thought the amount of drag of the gage indicated 1-32 inch plus. As I recall the case it was less than .008 plus.

If Mr. Vernon will kindly send us the geometry "involved" in his rule he will confer a favor, and if anyone will tell me where to get a table of trigonometrical functions that gives fractions of a minute, even as fine as seconds, he will meet a "long felt want." WM. S. ROWELL.

Teachers for Manual Training Schools.

Editor American Machinist:

I have been much interested in reading the letters printed in your publication in response to Mr. Stanwood's quiet expression of opinion regarding manual training instruction, or the "Shop Graduate vs. the Technical School Graduate" and as one acquainted with Mr. Stanwood, and knowing of his large experience, and interest in the subject of manual training, it has pleased me to notice that his remarks have penetrated below the surface.

There is, as anyone must admit, quite a diversity of opinion among teachers as to what manual training is. If, as some say, it is simply a teaching of the mind by employing the hand, then no doubt the technical or college graduate is all right as a teacher of manual training.

On the other hand, if manual training is intended to teach the use of machinery, tools, etc., then it would seem that the shop graduate was the man for the position. As manual training consists of both of the above propositions combined, it makes the problem somewhat complicated. To teach successfully, one must first of all know his subject thoroughly and be able to view it impartially from all points. Having the subject well in hand he must have the ability of becoming intensely interested, at least for a time, in that subject. Added to this there must be present the ability to present the subject in such

a manner and so clearly that the student cannot but become interested, and aroused to its vital importance also. Finally he must be able to lead the student to *do* and *think* for himself. (The "do" is put before the "think" advisedly, as my experience has shown me that to do is to leave the thinking straight ahead and not in a circle.)

Claiming that the foregoing assumptions are correct, I would like to give my reasons for believing that the shop graduate is the better man for teaching manual training. By a shop graduate is meant a man that can fill the position of foreman, assistant superintendent or superintendent in a shop of good standing. This means, then, that he must have a knowledge of drawing, pattern making, machine work, foundry processes, blacksmithing, pipe fitting, etc., and that he must be an expert tradesman in at least one of these trades. Also to be a successful foreman or superintendent one must be a teacher of men. In the shop this is spoken of as "breaking in" and is the teaching of new men the methods of performing the work in hand. A man with the ability to do this will, if given a chance at teaching manual training, develop in the majority of cases into the ideal teacher of such lines as he may be conversant with.

The technical graduate gets very little knowledge of the trades in most colleges and feels usually rather above them, and is thus not so interested in the subject, and, this being so, does not keep in touch with good practice.

The shop graduate, on the other hand, while believing in his own work, does *not* look down upon the academic work and is apt to take up the study of design, strength of materials, etc., and thus go on to a broader knowledge. One correspondent says "such men are most successful in college teaching." The reason this is so is that you cannot fool the college student. He is old enough as a rule to know whether he is being taught by a man that knows what he is teaching or not. The student in the secondary or graded schools has usually very little idea of the possibilities of the subject taught him and it is thus possible to palm off almost any incompetent upon such schools. The possibilities that lie in manual training teaching are not even suspected as yet in most cases and can only be attained by employing men that know their business and care more for results than they do for a nickel-plated outfit that looks as if the "finger of time" nor any other finger had ever been permitted to touch it.

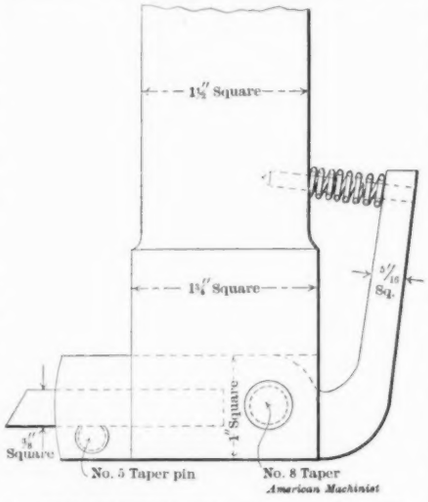
The graduate of the machine shop cannot fail, if of the sort I have outlined, of knowing more than the technical graduate of the possibilities that are in a given outfit, and he can produce results with it that would amaze the other man. So much for the mechanical and technical side of the work. Is there, on the other hand, any good reason why the shop graduate cannot acquire the good that a course of pedagogy does a man that is to teach in any line by using the vocations that are at his disposal?

Give the shop graduate a chance at this line of work and I believe that a better result will be noticed and good will be gained at once. BEAUCHAMP

A Self Relieving Tool for the Slotter.

Editor American Machinist:

I have been benefited very much by the "American Machinist," and I always look for the special tools that other fellows have found to their advantage. I send a sketch of a tool which I have designed and use with great satisfaction on a Sellers 16-inch slotter. It saves time in grinding tools, for the main point is not to have them drag back across the work. It



A SELF-RELIEVING TOOL FOR THE SLOTTER.

can be built cheaply, and will do hard work. The shank is of machine steel, with tool steel for the holder, and the tool of ⅜-inch square air-hardening steel.

C. MCLAUGHLIN.

Saginaw, Mich.

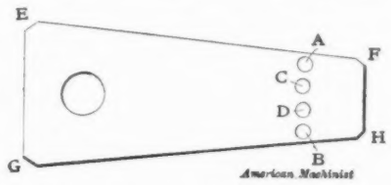
Spacing by a Supplementary Index Plate.

Editor American Machinist:

A scheme that we devised and used on our milling machine for indexing some numbers not prime, yet not provided for on our index plates, helped us out of trouble and may be a help to some of your readers.

For example, we wanted to cut 114 teeth for which no circle was provided. The worm gear in the head having 40 teeth, we must turn the worm $\frac{40}{114}$ of a revolution. This equals $\frac{13\frac{1}{3}}{38}$ of a revolution, or 13⅓ holes on the 38 circle of the index plate. We made a plate of ⅛-inch steel carrying pins at *A* and *B*, as shown in the sketch.

The pins were of proper size and spacing to fit any two adjacent holes in the 38 circle of the index plate. Holes *C* and *D* were of the proper size to receive the drop-pin of the indexing arm and were laid out on the arc of a circle of the same diameter as the 38 hole circle, dividing the distance



A SUPPLEMENTARY INDEX PLATE.

between *A* and *B* into three equal spaces. The lines *E F* and *G H* are radii of the circle on which the holes are laid out.

In operation the finder quadrant is set to cover a trifle more than fourteen holes. This makes it easy to locate the pins *A* and *B* in the thirteenth and fourteenth holes, and the pointer of the arm is dropped into the hole *C* or *D*, according to the spacing wanted. For instance, on the first setting ⅓ of an extra space is wanted, the next time ⅔ of a space, and the third time the plate is not used but an entire hole in the index plate is gained. Then we begin, using the plate and taking ⅓ of a space extra, and so on.

If the distance between *A* and *B* is so short as to allow insufficient stock for two holes between, the pin *A* alone may be used and project, say, ⅛ inch on both sides of the plate. Then the hole *D* only is drilled, and by turning the plate over we get, as we might express it in the above example, 14 holes less ⅔, or 13⅓, and, turned over, 13 holes plus ⅔, or 13⅔.

This method, while not universal, fills in a good many gaps in the indexing range of an ordinary milling machine, for instance, 51, 57, 63, 69, 81, 87, and so on. It might pay in some cases to make a plate or several plates to cover numbers divisible only by 5 or 7 or 11, although this would require more plates and more figuring than in the case of numbers divisible by 3. Many even numbers above 100 may be indexed by plates with one hole dividing the space between holes on the circles into two equal parts.

F. C. BLANCHARD.

Sweeping a Mold for Paint Mill Pan.

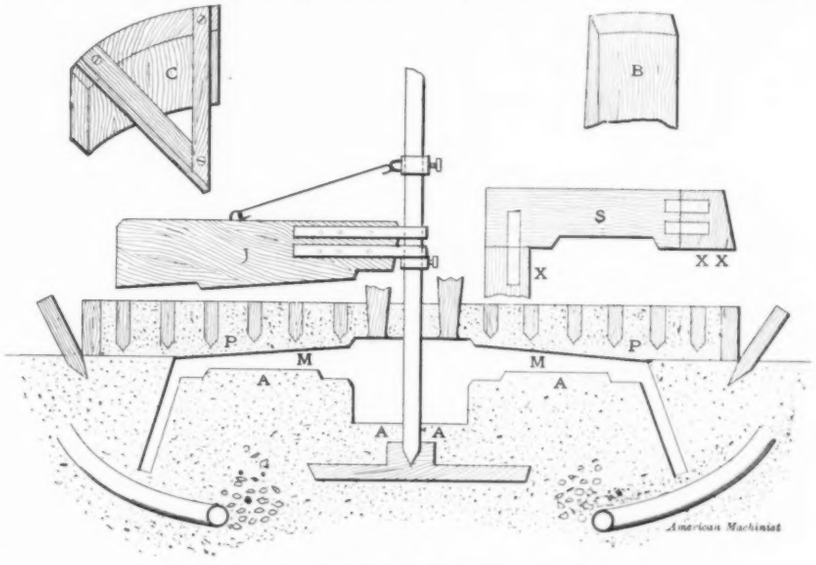
Editor American Machinist:

I offer a sketch of a mold for a grinding pan for dry paint or for grinding fire clay. Anyone familiar with this kind of work knows that it requires a casting of great strength to support the heavy rollers used to crush the material placed in it. These pans are made with the rim and the bottom separate and bolted together, or they are cast solid, as the customer may desire, the one here shown being solid. As the shop had not enough of them to make, nor the facilities for sweeping them up in

loam or dry sand, they were made as here described.

After the base of the sweep and the post are in position, the sweep *S*, without the addition *X X*, is bolted to the arms of the sweep and the outside of the mold is swept up to insure a true bottom. This sweep is then removed and the segment *C* is attached to the post, and the outside is rammed up. This leaves the face of the mold straight. Sweep *S* is again brought in use with the addition *X X* bolted on, and the outside of the mold is swept to the angle as shown. The lagging is then set around the mold and rammed up a few inches higher than the lagging. Now the long sweep *J* is attached and the top parting *P P* is swept up, after which the cope is rammed up and lifted off. The mold is then swept or scraped down to the line *A A A A* by replacing the sweep *S* with the addition *X X* taken off, and the addition *X* attached to sweep out the hub. After this the lags are drawn and the mold is dressed up as shown at *M M*. The center core is then set, the cope is replaced and weighted and the mold is ready for the iron. Care must be taken to have the bottom of the mold well vented by placing sufficient cinders in the bed and laying pipes to insure free egress of the gases. The lagging is the same thickness that the rim is intended to be, and a sufficient number are made to encircle the mold. Often we hear these little country shops spoken of in a disparaging way, but it is in these shops that some tall thinking and planning are done.

Elizabeth, N. J. F. B. SHAFFER.



SWEEPING A MOLD FOR A PAINT MILL PAN.

The Water Anneal,

Editor American Machinist:

As a reader of the "American Machinist," I have received benefit from "wrinkles" or "kinks" offered by skilled mechanics, and being glad to receive, I am also willing to give, when I can.

I have noted several references to the water anneal, and as I have not noticed any description of my method of performing this little time-saving make-shift, I will give it.

I heat my steel to red and wait for the red to disappear in daylight. If one end is small and cools too fast, I stick that end in the fire and hold the heat, so as to have the piece cool evenly. When the red disappears, instead of looking for a dark pocket or for a pine stick, I take my file to it. The file will probably slip over it to start with, as though it were greased; but it will soon take hold, and as you lift the file the surface filed will instantly turn blue; you will see no other color. But soon you will see a flash of red; then plunge it, and the steel will be as soft as it is capable of being made. While this rule never fails with me, I never use it except on small pieces and in emergencies.

Elyria, Ohio. W. H. CASTLE.

Suction for Lathe Chips and Dust — Lubricating Loose Pulleys — Boring Bevel Gears.

Editor American Machinist:

I have read the "American Machinist" for years and have often had handy pointers from it. I find, however, that it is much easier to read of these things than to write them, but to help things along I am tempted to try.

In the shop where I work we have a large number of small holes, ¾ to 2 inches, to bore in the chuck, and the boring makes some chips and lots of dust, which settles all over the lathe, gets on to the shears, makes the carriage pull hard and is a general nuisance. The lathe which I run has a hollow spindle, so I made a small exhaust fan and attached it with an easily removable tin pipe, the discharge end going outside the shop. Then I bent a piece of sheet iron so that it would fit the hole in the spindle tight enough to stay where it was put; this to be pushed in or pulled out to suit the different lengths of the hubs to be bored, and now the chips, dust and sand go out in the yard, and sometimes even a broken tool end goes out also.

If loose pulley remarks are permissible (not loose remarks about pulleys), I will tell how I cured a number of cranky ones by drilling a small hole in the end of the shaft right through to opposite the center of the loose pulley hub and then across the shaft, so that the lubricant would have two outlets, then tapping the hole in the end of the shaft and screwing in a compression grease cup. This leaves the cup outside the hanger box, and a fellow is in no danger of getting mixed up with the spokes of the loose pulley.

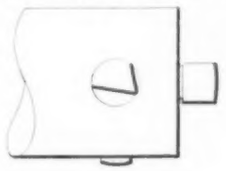
We have a great many bevel gears to bore. There was an article in the "American Machinist," January 26, 1899, about a rig for holding and centering bevel gears. I made use of this scheme, only we hold three different sizes and bevels in the same rig. It simply holds and centers a cast gear perfectly. JOSEPH LOWDER.

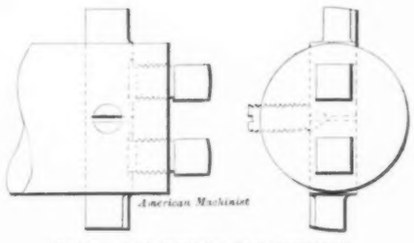
Pella, Iowa.

Adjustable Boring Bar Cutters.

Editor American Machinist:

I send you a sketch of an adjustable cutter for boring bars. I don't remember having seen such an arrangement in print, and it may possibly be of interest to some of your readers. The whole thing is so simple and easy to make that it hardly requires any explanation. The cutters are made preferably of round steel in two pieces, as shown, the conical pointed screw sets them out to any desired size, and the square-head screws act as binders. I have used this style of cutters for some time, and I find them a great convenience.





ADJUSTABLE BORING BAR CUTTERS.

H. B. ROBINSON, Supt.

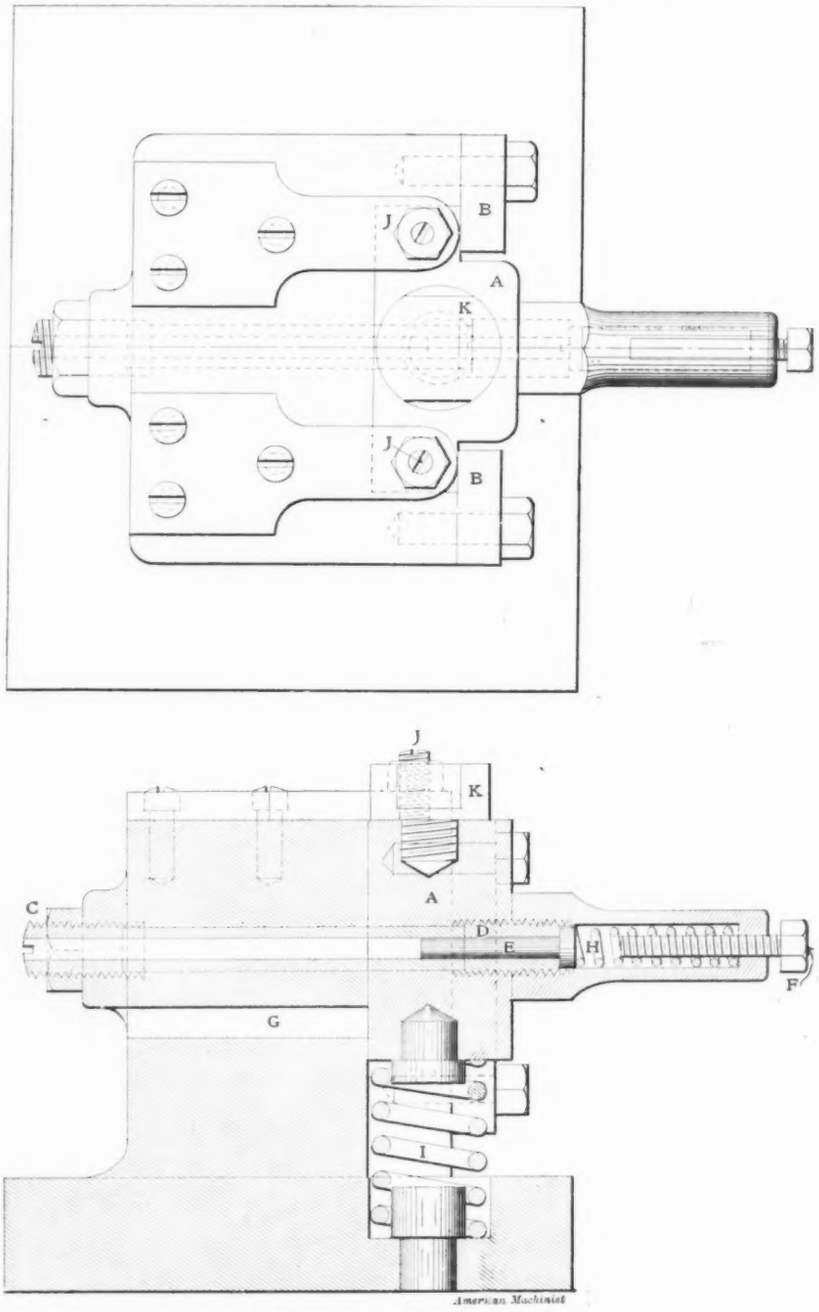
Allentown (Pa.) Rolling Mills.

A Fixture for Cutting off Wire.

Editor American Machinist:

I send you a drawing for a wire cutter (designed to be used in a punch press)

which has given good satisfaction, both in quantity and quality of work. *A* represents a slide nicely fitted and held in place by the plates *B*. The wire is fed through the hardened bushing *C* into the bushing *D*, which is also hardened, and forces the push-pin E back against the stop *F*, when the press comes down and cuts off the wire, carrying the slide down opposite the hole *G*, when the spring *H* will push the pin *E* forward, ejecting the wire cut off before the press returns on its up stroke, when the slide is carried back by the spring *I* into position for cutting off another pin, the press running continuously, cutting off from 80 to 100 per minute, according to the speed of the press. Different sizes of wire may be cut by substituting other bushings to fit the wire desired to be cut. The screws *J* act as stops for the slide, being adjusted so that the slide will stop when the two bushings are in line. An ordinary round punch or piece of steel fitted into the gate of the press acts as a push-pin to carry the slide down, the diameter being no larger than the hardened button *K*. A. M.



FIXTURE FOR CUTTING OFF WIRE.

How the Home Ownership Question Looks to a Machinist's Wife.

Editor American Machinist:

I have just finished reading what you and "Perseverance" have to say about workmen's homes. If you do not object, we will make this a "triangular" discussion, so I can come in with my views, or the woman's side.

I have been a machinist's wife five years, so I have had time to learn a few things about machinists and their ways of living. As yet we have not our home, because the money that would have bought a place we invested in a small machine shop. It is growing daily, and as soon as we have it equipped with larger tools (as we *mean* to have it) we will begin to prepare a home. But I wish to speak of less fortunate women.

This is a place of nearly 20,000 inhabitants; we have a large railroad shop and several contract shops, and I know no machinist that owns his home. I suppose they think quite the same as the man "Perseverance" tells of—they may lose their jobs and the home would not bring what it cost. In dollars and cents there may be no great advantage in paying for a home while living in it, but when we consider the great pleasure of living in our own homes, we certainly make far more than the 4-per-cent. interest the savings banks pay. We see so many machinists that drink; they do not live in comfort; their wives do not try to make home pleasant, and I feel sure renting is one of the causes for this condition of affairs. All women are born with the instinct to adorn a home, but few women are born with the instinct to adorn some other person's property. We like to have our little vegetable gardens, our flower beds, our neat walks; but what is the use having them while we have that feeling, "Here to-day and gone to-morrow"? When we once allow ourselves to think that perhaps we will always have that feeling, our interest in the place we call home is gone forever. On the other hand, we save towards a home; in a few years we are settled in a little place; no work is too hard for us to do. Well do I remember the day my mother and I built our brick walks; no undertaking is too great for our strength; and when we look over it and think "this is all ours," a feeling comes over us that is richer than a king's ransom.

And with this pride in our home and the happiness of possession, cannot we make our homes more pleasant for our husbands? And with happiness at home a man's mind should be clearer and better for his work in the world. Why do not all machinists think of this? Do they forget they take us "for better, for worse"? Then why not give us the necessary tools to make it "for better"? They should be willing to give us the same show they insist upon having in the shop.

Even should the time come when a move is necessary and the home is sold for less than it cost, when we consider the years of comfort and happiness that have been enjoyed, there is no sacrifice; rather the balance is on the other side. With a debt hanging over one, underpaid and discontented, I cannot believe the wife would

insist upon remaining in that place. A little business tact and arrangements could be made to dispose of the property. Even at the sacrifice of a few dollars and cents no great harm is done; we can try again at the next place. The sooner we begin the trying the better. Should we never save more, at least we have our home when old age overtakes us. Nothing is so pitiful to me as homeless old age or a wandering old couple. No doubt that one move with the increase of wages would have paid for six moves that year, but had the machinist made the six moves I think by the end of the year his wife would have been on the verge of insanity. Women like to travel, but they prefer to do it under other circumstances. There is no disputing the fact that the longer we do without a thing the better able we are to do without, and this will apply to property. But often with a little home to care for, a machinist will not be so quick to think he is mistreated at the shop. Could we get these men to consider the case just as their wives do, I feel sure a great deal of the roving disposition, drinking and thriftlessness among machinists would disappear. A MACHINIST'S WIFE.

Pine Bluff, Ark.

[We do not believe that machinists, as a class, drink very much. In fact, we think that, generally speaking, they drink very little. A machinist who drinks very much soon becomes worthless as a machinist.—Ed.]

Molding a Special Pipe.

Editor American Machinist:

On page 1006 Mr. Buchanan, of Wrexham, North Wales, tells about "Molding a Special Pipe," and I feel that a little friendly criticism is always a good thing, even for a Welshman who has heretofore given us numerous examples of his versatility as a molder and patternmaker.

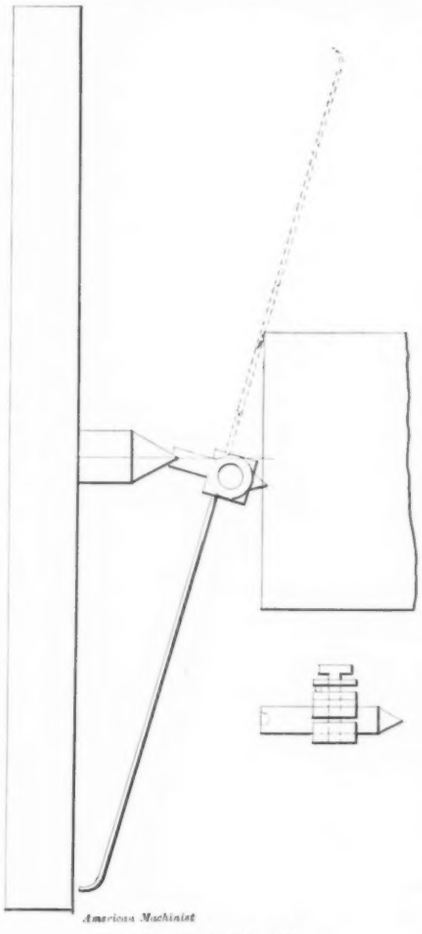
I would call attention to a very important omission in the making of that mold, as no provision appears for making the bell mouth of the pipe, though Mr. Buchanan assures us to the contrary. If looked at closely it will be seen that the core swept up inside that pulley rim forms the conical flange and thickness of metal around the bell mouth only, making it necessary to use still another core to rest in the print space for forming the inner section of the bell mouth, which should be fastened to the main core, as it is to be regarded as a part of the same, though it would be necessary to shoulder down some to give thickness to the small end of the bell mouth, and I'm afraid this would make quite a long job of it.

In making that strickle for his core, I trust he fastened that finger for shaping the flange, to the body of the sweep, by screws only; if not, he would have to raise the pulley rim off the plate to get the strickle out, unless the centering plug could be removed from top or bottom. The sketches do not show either expedient, which makes one believe that he not only sawed the core in half, but the sweep as well. OLD BOB.

Lathe Indicator.

Editor American Machinist:

Judging from the number of articles which have appeared on this subject, the value of lathe indicators is commencing to be more and more recognized. A very simple and useful one can be constructed on lines similar to the one shown in the sketch. It is simply a rod centered to fit the lathe centers, or one lathe center and the work, as the case may be, and a needle attached in a similar manner to the needle of a surface gage. It can be used in a



A LATHE INDICATOR.

variety of ways. For instance, to chuck a piece of work to be bored on the carriage place one end against the live center and the other against the center punch mark, which locates the hole. Now, on rotating the indicator on these centers, if the needle does not travel parallel to the face-plate, the work is not chucked true. It may be necessary to turn the face-plate and needle together if the face-plate is not true. Of course, this will locate only one point of the work, and care must be taken to chuck the piece so that the other end of the hole will come where it is wanted.

By having suitable centers in the ends of the rod, it can be used to set the tail-stock center in line. The method is the same. Sometimes it can also be used to advantage in chucking work on the face-plate, as it is easier to rotate the light indicator than to pull a heavy face-plate round. This is especially true when the work is liable to upset your calculations by sliding off on the ways.

For everything except the last case the rod should be short, in order to magnify the error as much as possible. The live center should also be true.

A Word for String Jigs.

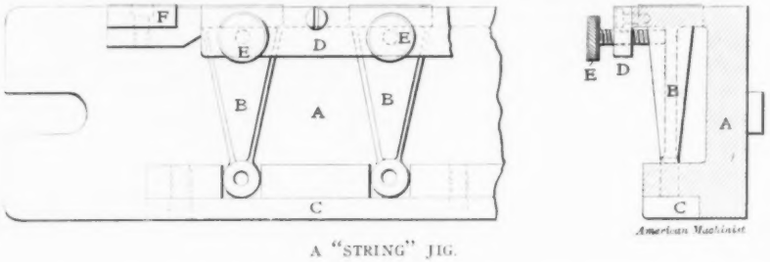
Editor American Machinist:

After several years' experience in making and using jigs in a number of modern machine shops in different parts of the country, I cannot quite agree with Mr. A. B. Christman where he says, on page 862, that "the use of string jigs is in most cases to be avoided." They can be used very frequently, and they will give good satisfaction in the saving of time and labor and in the accuracy of the work, if properly designed and constructed and if the machine is in proper condition. Where extreme accuracy is required in milling machine work all depends on the condition of the machine itself and on the correct alinement of the consecutive places or fixtures on the jig for holding the work. Of course the proper size and condition of the cutters and the experienced handling of the work also are to be kept in view.

I believe that a wide application of this principle in jig making, especially in the milling of large numbers of pieces of any one shape and size, will result in a saving of considerable expense in shops where standard machines are constructed in large quantities. This method of stringing the work in a milling jig also permits the operator to attend to more than one machine when handling small work, which with the single piece system could not be done to advantage, for, after having fastened the required number of parts in the jig and started the cut, the table is forced to travel a considerable distance before the cutter reaches the end. Even when running one machine there is a perceptible saving in cost of production; for often more time is consumed in stopping and starting the machine, brushing and wiping away the chips and oil and inserting a fresh piece of work than is necessary when several are located in position at one time.

It is economical when designing "string" or gang milling jigs to arrange to have the clamps or other holding parts as near to each other as is consistent with the easy manipulation of them, in order to save time and minimize the distance the table will have to travel after the cutter has finished one piece before it begins on another. In many cases the ends of cast-iron or other metal brackets have to be surfaced, and a simple way of doing this class of work in gang milling jigs is shown in the accompanying sketch. Here

is a plan and section of a milling fixture for taking a cut on the ends of pieces used in certain special machinery. *A* is the casting, planed on the under side, with a tongue extending its entire length to fit the slot in the platen. Across the jig, at equal distances apart, are machined the openings to admit the brackets *B*, giving bearings at each end and holding them in place sideways. The straight-edge *C*, for the work to butt against, is made prefer-



A "STRING" JIG.

ably of flat, cold-rolled steel, and fastened to the side of the jig by ¼-inch filister head screws. Secured to the elevations, that rise from the body of the jig between the work, is the flat bar of steel *D*, in which are the clamping screws *E*. The holes for these screws are drilled and tapped on an angle of 5 degrees from the vertical (this does not appear in the sketch), so that when they are screwed down to hold the work they have a tendency to force it back against the piece *C*. The hardened gage plate *F* indicates clearly the method of setting the end of the milling cutter. While there is nothing of special importance in the design of this tool, it may serve as an example of how work can be done in jigs of this class, and suggest their superiority over the single piece method.

C. H. ROWE.

The Average Library of the Average American Mechanic.

Editor American Machinist:

The average library of the young mechanic is small indeed. The small amount of money that in time would pay for a fair library is spent instead in sports, and I think it safe to say that a large number of the younger mechanics seldom think of a library. I am a lover of good books, and I have a good library, written by the best of mechanical writers. To accumulate a cheap and good library, subscribe for a few good mechanical papers, such as the "American Machinist"; at the end of each year get an index and have the year's numbers bound. In a few years the young mechanic would be surprised at and proud of his library, and find it of practical and constant value.

PAUL S. BAKER.

Muscatine, Iowa.

A Surface Grinding Rig.

Editor American Machinist:

The sketch is supposed to show a cheap rig for surface grinding. I had to finish turning tools for brass, such as shown at *A*. As it takes a lot of careful cross-filing and draw-filing to produce a smooth surface without any scratches, I tried it on the polishing wheel, as shown. Three cold-rolled steel rods clamped to an angle-iron and this clamped to the bench of the wheel, and that's all. The outside surfaces of the straight rods form a true plane over which the piece is moved while grinding. The angle-iron is set so that it will allow the wheel to take out the tool-marks. It is not necessary to have the angle iron exactly in line with the wheel spindle. The sketch shows the tool to be ground in its extreme right-hand position. I just had to rub it over with emery cloth after the grinding, and this did away with the marks caused by the rubbing of the polished surface over the smooth rods.

Milwaukee. J. SCHURING.

Editor American Machinist:

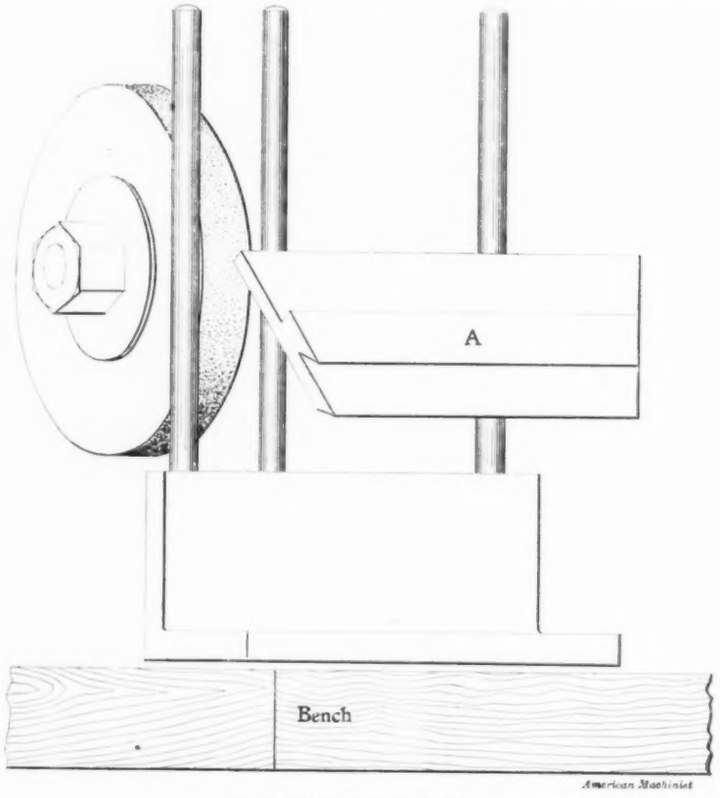
Some years ago I worked in a shop where we had no surface grinder, but needed one very badly at times. So I suggested that we might convert a common dry emery-wheel grinder into a surface grinder at the expense of a few dollars. I have lately seen the same arrangement used by a builder of a cheap surface grinder, and it works very well for most kinds of work.

Bend two pieces of 3x¾-inch flat iron into the shape of Fig. 1 high enough from *D* to *F* to suit the emery grinder and 12 inches or more wide. Drill and tap two or three ½-inch holes at *A*, *B* and *C* in both sides two or three inches apart. Drill a ⅝-inch hole in both of the feet *D*. Put two ½x2-inch pointed set-screws with check-nuts in two opposite holes. Clamp this stand to the floor with screws at *D*. Plane upon one side a 1½-inch thick cast-iron slab *E*, Fig. 2, as wide as the inside of frame and 2 feet long. Make a countersink on each side at one end to receive the pointed set-screws.

For support at the other end, take the other stand and drill the holes *A*, *B*, *C* to let a ½-inch screw *through* and clamp a piece of 2½-inch square wrought iron *H* between the uprights. This square iron is drilled and tapped for ½-inch screws in the ends, Fig. 2, and for a ⅝-inch screw in the center to receive a hand-screw *K* with check-nut, whereby the table is adjusted under the emery wheel as the work requires.

Tighten this stand to the floor like the other, both at an equal distance from the emery-wheel spindle, the tops parallel with it and about 20 inches apart, and brace them from the wall behind, or from the stand, as may be convenient, the more rigid the better.

In working under an emery wheel of a surface grinder it, of course, makes no



A SURFACE GRINDING RIG.

difference at what angle the table stands as long as the work does not slide off when left alone, which would be bothersome.

This rig will always grind the two sides of the work parallel if the slab or table is straight, and the emery wheel runs without shake in its bearings.

The next important thing is to get the wheel straight and true. If an emery wheel it can be trued with a diamond. This is slow and tedious work, but if a carborundum wheel, which in my experience cuts better, we feel like keeping the diamond away from it, as it wears the diamond very fast, and in either case I prefer to use a rotary emery-wheel dresser. I use the "Huntington" and place it on the table of the surface grinder and move it back and forward under the wheel, its axis being kept parallel with that of the wheel, and feed the table up carefully. This trues up the wheel better than any other way that I know of and very rapidly

J. J. HAGELGREN.

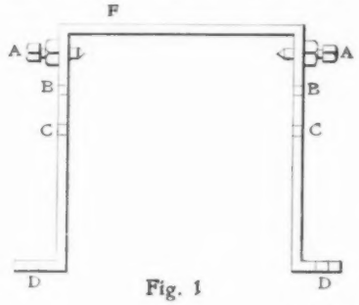


Fig. 1

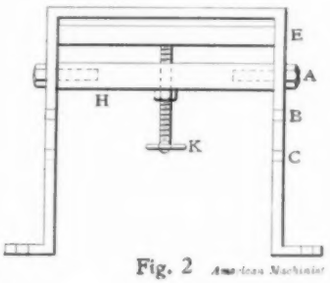


Fig. 2

A SURFACE GRINDING RIG.

Machining Locomotive Side Frames on a Small Slotter.

Editor American Machinist:

Having been urged to give the readers of the "American Machinist" the benefits of the experience gained in turning out work for two 100-ton locomotives on a 12-inch slotter, a job that presented several new problems for solution, the following was prepared from most exhaustive notes taken during the progress of the job. The slotter used was a fairly rigid tool for a 12-inch, but was not thought strong enough in the feed mechanism for handling the side-frames until the plan of carrying the frames on the three rollers was tried, and the feed was then found ample to readily shift the load, the frames weighing several tons. The horses were carefully leveled, and on those the rollers for carrying the frames were placed, and the whole job could easily be shifted by hand, even when working on the extreme end.

Before beginning the job a new toolholder for the slotter was made and to this tool is due considerable of the credit that the job was so satisfactorily accomplished. The holder was made of soft steel shaped as in sketch *A*. This tool is recommended to the trade as a money maker. The roughing tools *B* were four in number—two lefts and two rights—made of good steel, but were not very hard. An important auxiliary in this job were the four parallel strips *C*. The frames were the first part of the order turned out, and these were carefully laid out with lines and punch marks. Commencing at *g*, the end was faced, and with the same setting the recess for the tail bars was cut, first running in a 1-inch square nose tool 1-16 inch from the lines for roughing cut and then finishing the sides and fillets with a round nose tool of the proper radius and the bottom with square nose tool.

In setting the work the point of the tool was not traversed along the line that it was desired to cut to, but the line was paralleled to the base or the square of the slide by the use of two straight-edges and a scale, as shown in the sketch. This method was found entirely satisfactory, a time-saver and possible of application on a multitude of other jobs. The cut on the jaw was begun by starting a roughing tool about 1-16 inch from the line, taking all the feed that the machine would handle. The depth of the cut was sometimes an inch, which was considered good work for such a small slotter. The tool was run to *b*, then the surface between *b* and *c* was roughed out and finished, then a return cut taken on the jaw from *b* to *a*, finishing to the line. End *a* was then squared. The work was next shifted for finishing jaw *d* to *c*, then again for squaring *d*. The circular portion *f* was roughed out and finished by shifting with hand feed and smoothed by the use of tool *D*.

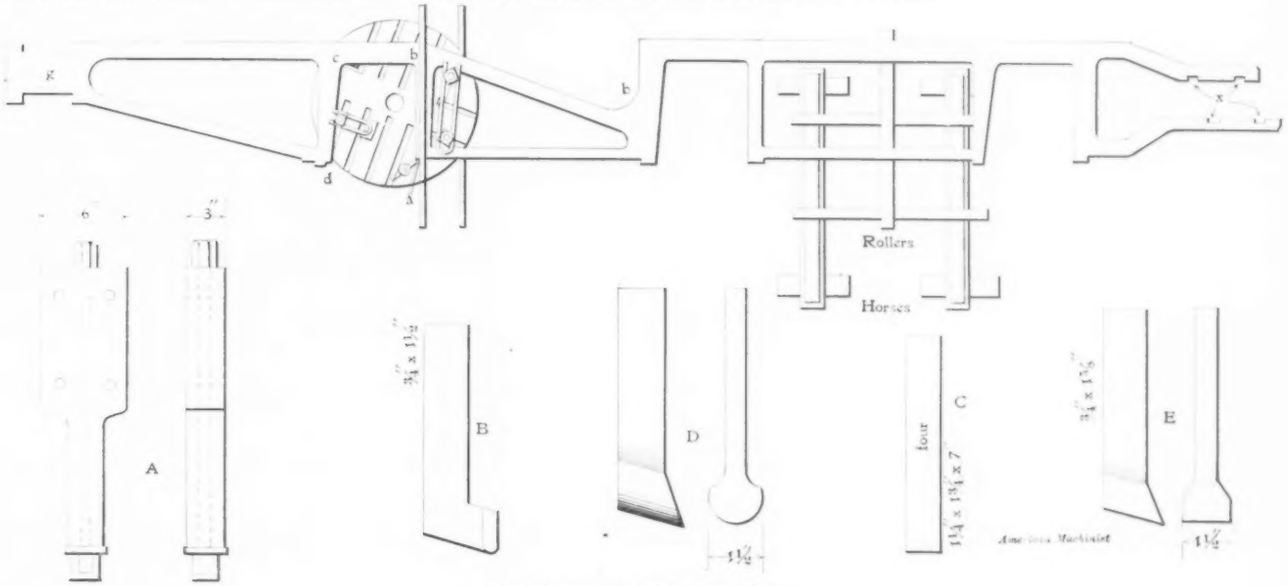
In cutting the keyways *x* the tool *E* was used, taking one cut with a feed about 128 to the inch. Soda water was used on all the tools. The work on these frames was as good as is ever done on such a job, but the time was too long to make it profitable.

FRANK RATTEK.

A Casting Breaker.

Editor American Machinist:

I have noticed that at many small foundries they seemed to have poor ways of breaking up old castings, and I believe that some of your readers would be glad to know what is used very successfully for this purpose at steel works and large foundries where much cast scrap is to be broken.



MACHINING LOCOMOTIVE FRAMES.

Fig. 1 shows what is ordinarily called a "drop," and it seems to be the best thing that is used for the purpose. As generally made, it consists of a tripod with wooden legs set in cast-iron feet, while the tops of the legs are connected together with a single casting, which in turn supports the sheave wheel bracket.

A 6,000 pound, egg-shaped ball is hoisted by means of a rope over the sheave wheel and wound up by an electric hoist engine. The ball is raised as high as is necessary and then released and allowed to fall upon the casting to be broken.

The ball is connected to the rope by means of a latch hook, as shown in Fig. 2, and is cut loose by unlatching the hook

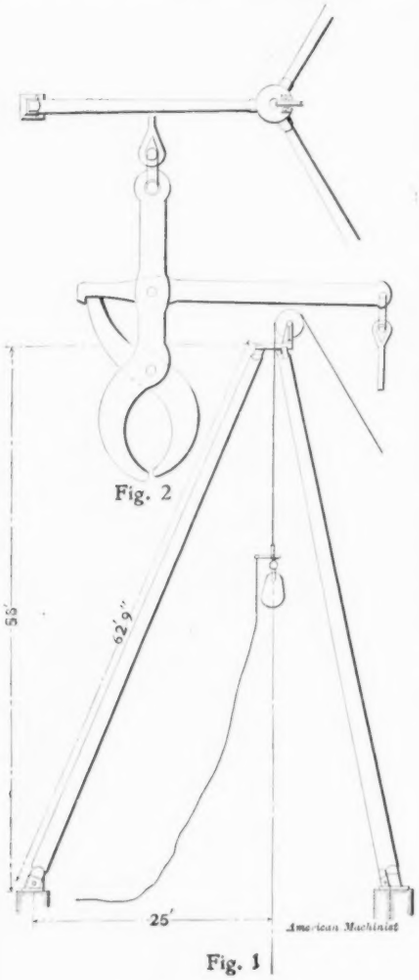


Fig. 2

Fig. 1

A CASTING BREAKER.

by means of the rope that hangs from the lever arm of the latch.

The size of the "drop" shown herewith is about what is generally used at a steel mill for breaking scrap, and of course would be much larger than would be required at a small foundry, but the same thing on a smaller scale may be used very effectively. A small "drop" might be made so that the ball could be raised by hand and yet do very good service. A better and more effective one would easily be manipulated by a small crab. Such a "drop" might carry a ball weighing 500 pounds, which, raised to 20 feet, would answer the purpose very satisfactorily for a medium-sized foundry.

THE CAROLINIAN.

Thin Disk Patterns and Bracket Work.

Editor American Machinist:

The sketch shows a rather novel way of building up thin disks, also a good way of making brackets. It will be seen by Fig. 1 that the different sections of the plate are arranged so that their joints are tangential at the hub instead of radial. Each section is cut with the grain running as indicated. With the grain standing thus the pattern is less liable to become too small in diameter by shrinking, as it is apt to do if built up of segments as usual. It is best to get them out with the ends cut straight and all jointed alike at the proper angle on the "trimmer." When placing them on the face-plate I find it a good way to first true it up in the lathe, mark the inner and outer circles and divide the latter into the right number of divisions; then, after rubbing the face-plate over with paraffin, the first layer can be quickly tacked to the plate and the edges can be properly glued without danger of sticking to the face-plate. The larger circle is then drawn, the divisions are stepped off again, and the second layer is glued and bradded to the first, and so on, crossing the joints in each as shown. When dry the center opening is turned out to receive the hub, if one is required, as shown at *A*, having a shoulder turned on it, so that it will be stronger and not so likely to give away when drawn from the sand.

The patternmaker is often called upon to attach brackets to work, and the drawing may call for them to make an easing with the connected parts in a way that must produce a "feather edge" at the ends, which will be understood by referring to Fig. 2. If the grain of the wood is placed as shown and the bracket made of two pieces, mitered at the center, the glue will hold the wood in place much better than if the grain ran in any other direction. If the miter joints are "sized"—that is, a coat of glue applied and allowed to dry first—then the second coat will hold firmly and the two pieces can be handled as one.

WM. NEWTON.

Oneonta, N. Y.

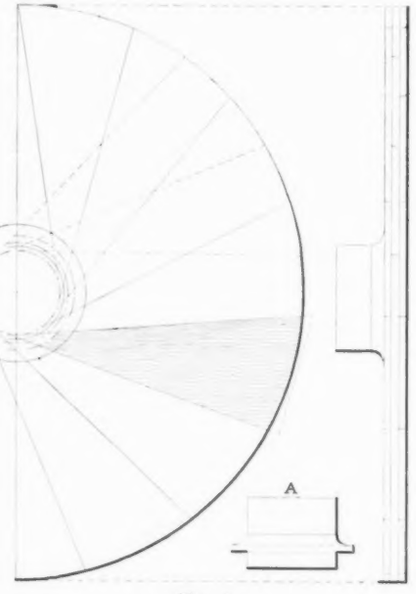


Fig. 1

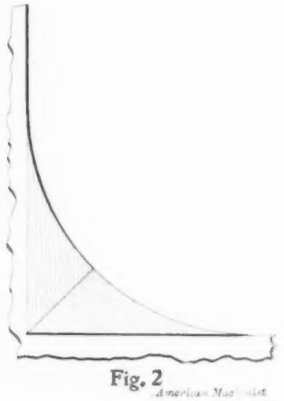


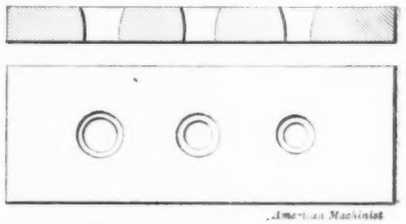
Fig. 2

THIN DISK AND BRACKET PATTERN WORK.

Drawing Small Tubes.

Editor American Machinist:

There was an article on page 264 on the drawing of small tubes. The tubes were said to be oil, but not air tight. If anyone wishes to draw small tubing, up to ½ inch, that will be air tight, use sheet steel instead of brass, copper or German silver.



DRAWING PLATE FOR SMALL TUBES.

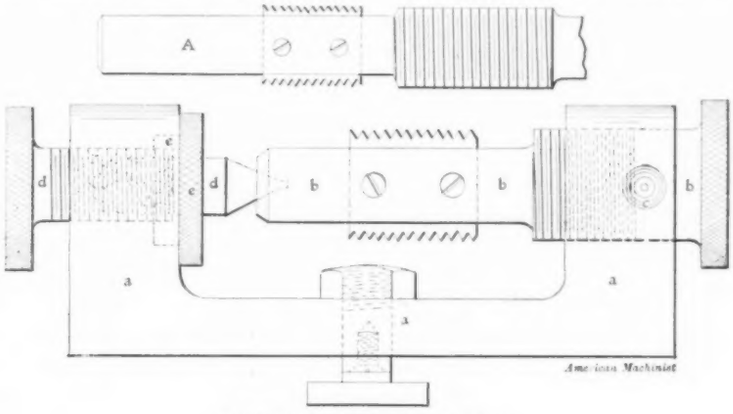
Cut the sheet into strips as nearly parallel as possible; the tubing will curve somewhat according to the lack of parallelism. Draw the tube to the desired size, or, better, one size larger, using plenty of oil; anneal and clean with emery cloth and draw through the desired size hole without any lubricant. Steel needles for hypodermic syringes are made in this way. Of course any kind of tubing can be silver soldered. The holes in the drawing dies

should be drilled and reamed to the shape here shown, hardened and polished. There should be made more holes between the different sizes than here indicated. The less the holes differ in diameter the more satisfactory the tubing. SANDS.

Milling Staybolt Tap Blades.

Editor American Machinist:

We use in our shop many staybolt taps with inserted blades, as sketched at *A*, and I show here a fixture for the milling machine designed for cutting the teeth



MILLING STAYBOLT TAP BLADES.

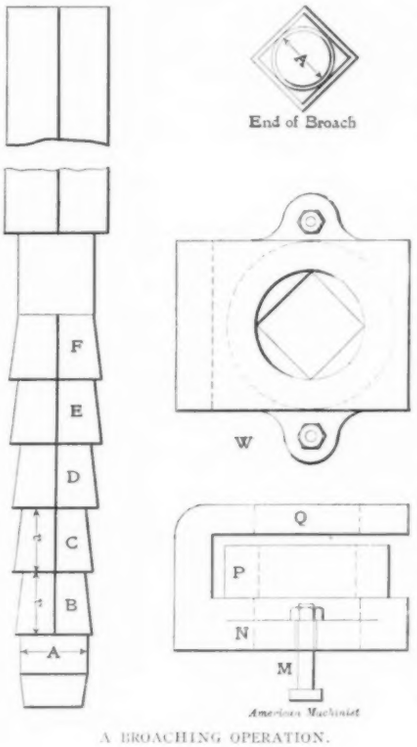
on the blades. The pitch for all the taps is the same, 9 threads to the inch, and with this rig a boy can do blades for 12 to 14 taps a day, where a man could not turn and chase more than 3 in the same time. The main casting *a* has a tongue on the bottom fitting the slot in the machine platen. It is placed obliquely enough to give the correct pitch angle to the teeth that are to be cut on the blades. The mandrel *b* has a 9-pitch thread on the large part of it fitting a tapped hole in the upright. There are two opposite holes drilled in *b* for the point of the dowel screw *c*. When one edge of the blade has been cut the screw *c* is drawn back, *b* is turned half way around, the screw is run in again and everything is right for milling the other side. The tail screw *d* has to be adjusted each time and the check-nut *e* set up. The position of the mandrel is such that the blade during the milling does not stand exactly vertical, but is inclined forward, so that the heel is cut about .003 inch lower than the front. This gives plenty of clearance. The milling cutter was milled on a Brown & Sharpe milling machine, using the graduated disks on the feed screw for spacing the thread correctly. FRED W. UNGER.

A Tool for a Broaching Operation.

Editor American Machinist:

The sketch shows a tool that I made several years ago for making square holes in a large quantity of brass washers. Where work of this kind is not done regularly, if a slotting machine is available, my tool can be used with very good results.

The washers were first drilled, turned and faced. Part *A* of the tool was turned to fit the hole of the washers, the end being tapered to find the hole easily. *B*, *C*, *D*, *E* and *F* are squares, increasing successively, *F* being the size of the hole to be broached. The lengths *a a* are a little less than the thickness of the washers. The work was done on a slotting machine on whose table a jig *W* was fastened. In the bottom *N* a square hole was made a little larger than the holes of the washers, and on the top part *Q*, used to strip the washers from the tool, a round hole. In broaching machines the tool is taken out from below the work after it has been driven through, which is good practice. The tool must be made and tempered very carefully to insure satisfaction. Squares *F* and *E* must not differ much in size, while squares *B* and *C* must do the larger part of the roughing. The holes drilled in the washers should be a little larger than a



A BROACHING OPERATION.

circle inscribed in *F*. The work was done in a remarkably short time and the holes were uniform in size. Some time later we used a similar tool for broaching square holes in cast iron with good results. JOSEPH MENEGUS.

Wire Bending and Forming Dies.

Editor American Machinist:

One of the uses to which forming and bending dies are often put is the production of bent and formed wire parts from either slender or heavy stock. As an instance of what can be accomplished in the bending and forming of comparatively heavy stock in two operations by the use of simple dies, we show at the top of Fig. 1 a length of wire and the results of the two operations. The stock used was 5-16 inch Bessemer rod, and the parts as finished were used as clasps on a patented lock.

Before starting on the dies it was necessary to determine the exact length of wire required. This was easily accomplished. The templets for the first operation were got out and we were ready for the die. The die is made so that the bending of the work will be progressive. The bolster or die block *J* was first planed and two square bottomed channels let in crosswise for the end pieces *P P*. These pieces were of tool steel and were worked out and finished to the shape shown—that is, to a snug fit within the channels in the bolster and with about .007 inch surplus stock on the inside face of each. The tops of these pieces had a half-round groove let in at *S* to act as locating points for the work. Holes were let into the back for the fastening screws *Q Q*, two to each. After these holes were tapped and a hole let into one piece for the stop-plate screw *R*, the pieces were hardened and tempered, leaving the portion which was to do the bending very hard and the rest a blue. The two pieces were then fastened in and the inside faces were ground until the distance between the pieces was exactly as required—that is, the same as between the points *U U* on the simple wire after the first operation.

For the part *O*, which is the bending die proper, a piece of well-annealed tool steel 7/8 inch wide was planed and squared and the ends finished so that it would fit nicely between *P P*, as shown. This part *O* was then clamped to the face of the bolster resting between the two pieces *P P* and the two holes for the stripper screws *L L* were let in. The piece *O* was then removed from the bolster and the forming and bending face was finished to templet, first in the shaper and then with the file, all points as smooth as possible. The two holes *M M* were tapped, and the die was hardened and only slightly drawn. The stripper screw holes in the bolster were then counterbored to admit the stripper springs *N N*. The springs had to be very stiff, to allow of the progressive bending and forming of the work. After polishing all the work-

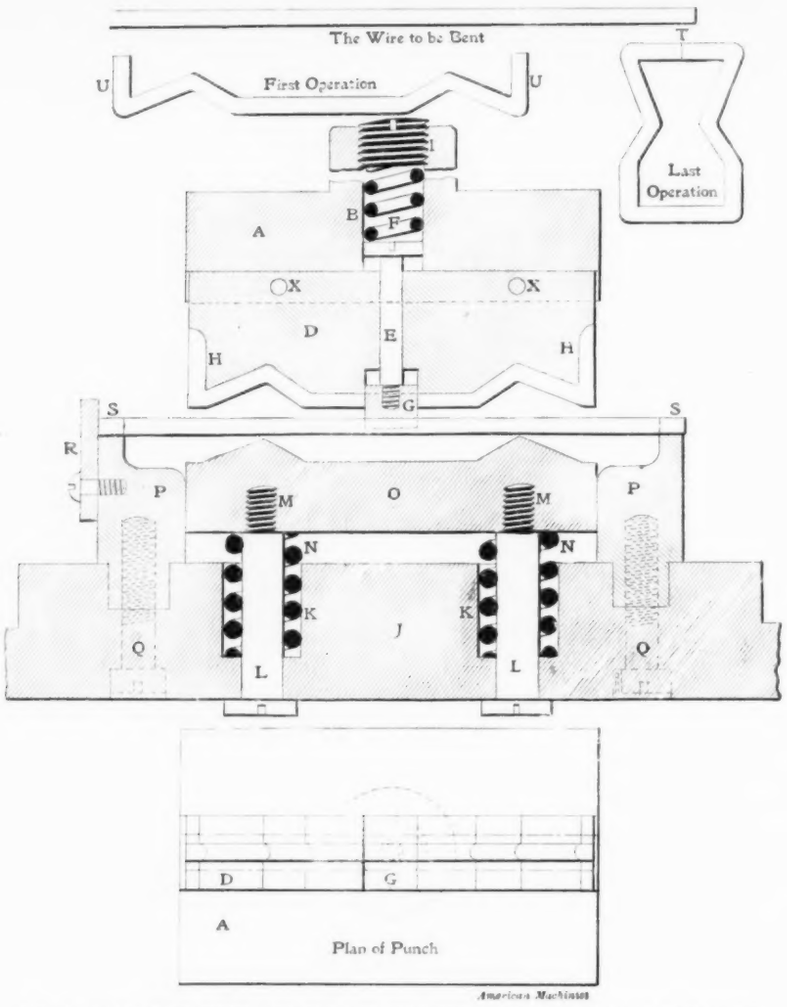


FIG. 1. SAMPLE OF WORK AND DIE AND PLUNGER FOR FIRST BENDING OPERATION.

ing surfaces and fastening on the stop-plate *R* all parts were assembled and we were ready for the punch.

The holder *A* is of cast iron. After turning the stem a hole *B* is bored completely through it, tapping it at the upper end for the stripper spring adjusting screw *I*. The punch *D*, of tool steel, is first planed, fitted to the holder *A*, driving tightly into the dovetailed channel and leaving it long enough for fitting into the the die. The punch is driven into the holder and the holes are drilled and reamed for the two taper locating pins *X X*. The center for the hole for the stripper screw *E* is then located through the hole *B* in the stem of the holder, drilled and reamed. The locating pins are then removed, the punch driven out and the square channel for the stripper *G* milled in across the face. The face of the punch is then fitted perfectly within the die and finished smooth. It is then set up on the milling machine, and, by using a butt mill, the cutting edges of which are finished to the same radius as that of the stock to be bent, a groove *H H* is milled into the face and the ends, in depth the same as the diameter of the stock to be bent. This channel is then filed smooth and symmetrical at all the corners and angles with a riffler and polished with oil and emery to as good a finish as possible. The punch is hardened on the bending face and ends, and tempered to a very light straw.

The stripper *G*, of tool steel, is made and fitted to the slot in the punch face and finished with a groove in the center to coincide perfectly with the punch face when resting in the bottom of the slot. A hole in the center is tapped for the stripper screw *E*, the spring *F* is made and also the adjusting screw *I* and all parts are assembled.

The length of wire to be bent is rested in the locating grooves *S S* and endways against the stop plate *R*. The punch is set to just bottom in the die. As it descends the tension of the springs *N N* is sufficient to allow of the angular bends being accomplished without the die *O* descending. As the face of the punch strikes the die *O* the ends of the wire are bent up into the groove *H H* in the ends of the punch, which continues downward until the die strikes the face of the bolster. As the punch rises the die rises with it, and the work clings to the punch until it has risen above the die face, when it is stripped by the stripper *G*, and, as the press is tilted, it drops off the die into a receptacle at the back of the press.

For the finishing operation the punch and die shown in Fig. 2 are used. The die is finished from a good solid block of tool steel to the shape shown—that is, to dovetail into the bolster *E E* and the part *C C* to templet, rounding off the corners, as shown, and with a groove along through the top faces at *F F* as locating and centering points for the work. A stop plate

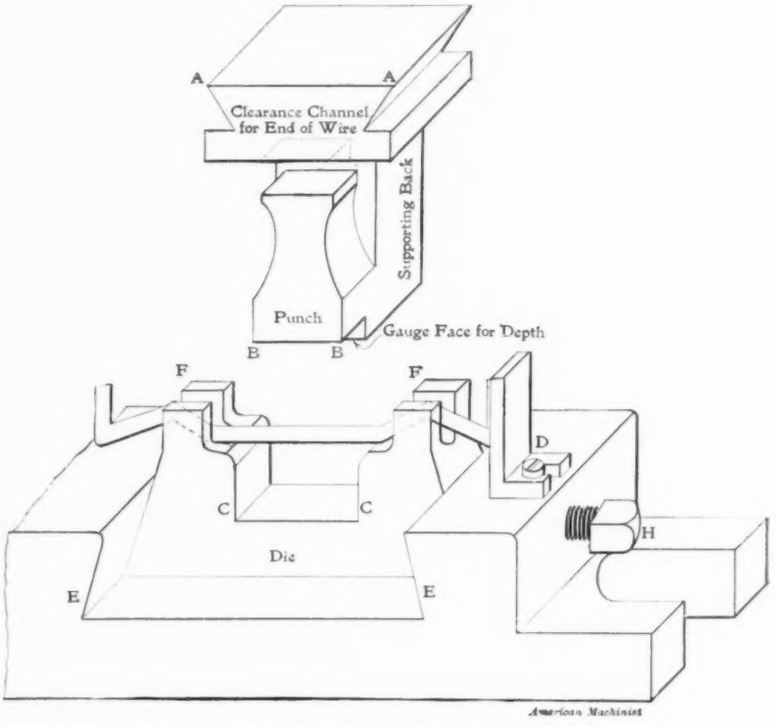


FIG. 2. DIE AND PLUNGER FOR LAST OPERATION.

fastened to one side of the bolster acts as the endwise locator. The die is hardened and drawn, driven into the bolster and located by the set-screw *H*. The construction of the punch requires no description. The punch and die are set up in the relative position shown, the work is located within the grooves *F F* and against the stop plate *D*. The punch strikes the work in the middle and bends it into the die, which causes the ends to spring up and form around the punch, the ends coming together tightly at *T*, Fig. 1. As the punch rises and the work with it, it is stripped off by hand.

These two dies were designed for the production of parts which were required in large quantities, and we believe they are both in design and construction about as substantial and simple, as well as rapid in production, as could be devised, as the work is produced in exact duplication and free from marks or bruises and results are attained in these two operations which, as a rule, require three to produce.

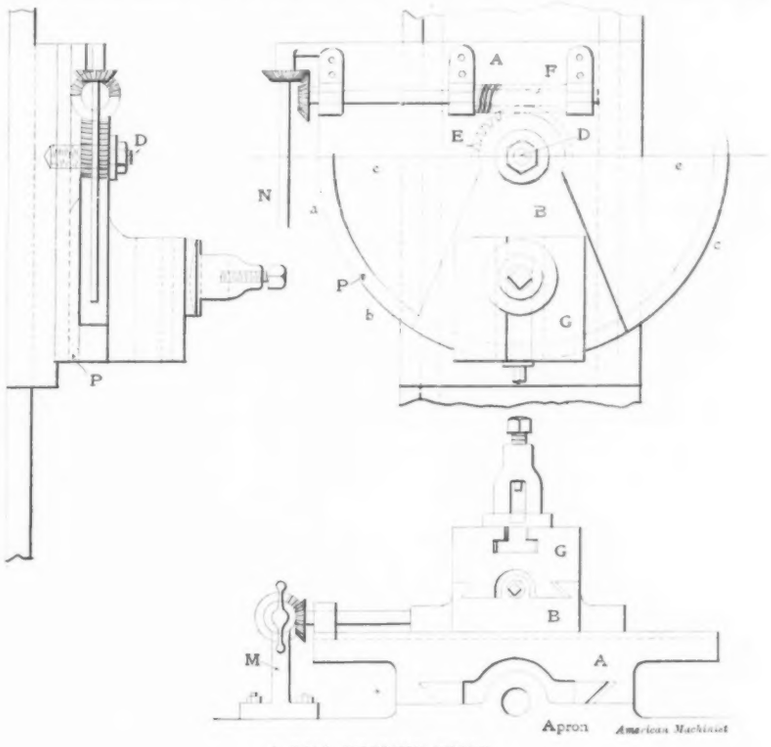
WILLIAM DORAN.

A Ball Turning Device.

Editor American Machinist:

The sketch shows a ball or link-end turning device. Piece *A* is put in place of the cross carriage, and has two extensions *c e* that form the bed on which *B* rides. *B* turns on the tool steel stud *D*, the center of the worm gear *E* and of the circumference *a b c*. *B* bears only on the strip *P P* and on a central hub. *B* is dovetailed to receive the rest *G*. The worm gear *E* meshes with the worm *F*. On the end of the worm stem there is a bevel gear meshing with a bevel gear in the end of stem *N* which is supported by bracket *M* on the carriage. Pin *D* must be fitted carefully on the hard bushing driven into piece *B* in the center of the worm gear. The device should be covered with a case of Russia iron to prevent chips from interfering with the operation. *A* is tightened in place by two set-screws. Its proper place is when the center of pin *D* is exactly under the center line of the lathe.

JOSEPH MENEGUS.



A BALL TURNING DEVICE.

How Carbons for Arc Lamps are Made.

Editor American Machinist:

I send herewith a sketch of a mold for making carbons for arc lamps, as I thought it would interest some of the readers who are not familiar with such work.

Fig. 1 is a view of the mold without the frame. It shows the grooves in which the carbons are made, the space which is shown between top part *C* and bottom part *D* being the thickness of carbon that holds each of the carbons together until they are baked, after which they are broken apart. Fig. 2 shows the mold and frame together, as it is when in use, and Fig. 3 is the frame alone. Fig. 4 shows the back of frame, marked *A* in Fig. 3, the circles being the half-round recesses that make the tips on the carbons. *B*, Fig. 3, is made the same as *A*, with the addition of the lug shown, to be used as a handle to open the frame when taking out the carbons.

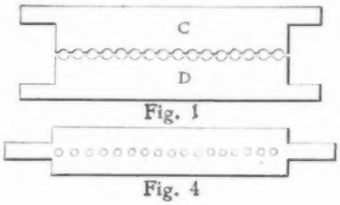


Fig. 1

Fig. 4

MOLD FOR ARC LAMP CARBONS.

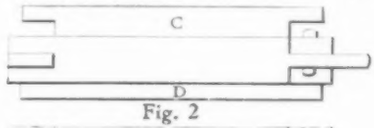


Fig. 2

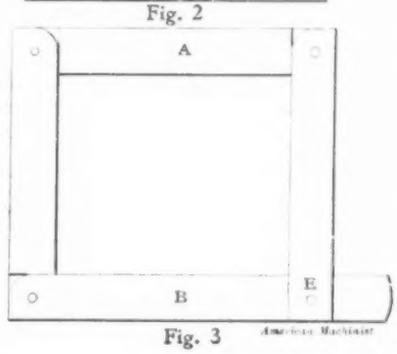


Fig. 3

The method of using the mold is as follows: The bottom part *D* and frame are put together, as shown in Fig. 2, but with top half *C* lifted off. The space between mold *D* and the top of the frame is filled with carbon, after which top half *C* is put on and the whole is put under a hydraulic press, which receives sufficient pressure to force the top half down to within 1-16 of bottom half. The mold is then taken out of press, the pin *E* (Fig. 3) is knocked out, the frame is swung open, the top is lifted off and the batch of carbons is slid on to a tray made specially to receive it, after which they are baked. The carbons are then broken apart and fixed ready for use. The grooves are made about 1-64 inch in diameter and ¼ inch in length larger than size called for, as the material shrinks in the baking. The length of mold is not shown, but can be readily seen by Fig. 3, as the frame fits all around the mold.

C. ALIPER.

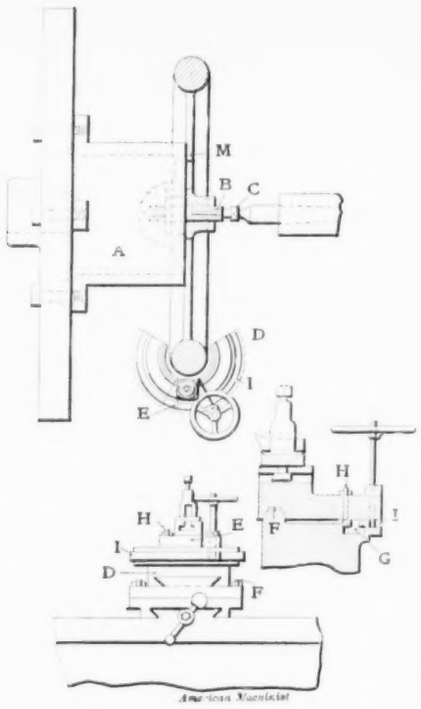
A Hand-Wheel Rim Turning Rig.

Editor American Machinist:

When a large number of hand-wheels, 8 inches diameter and upward, are to be turned, the rig shown in the sketch may be used. While the rim of a hand-wheel does not need to be perfectly round, it must be smooth and polished to satisfy the eye.

The turning rig consists principally of a piece *D* that is put in place of the compound rest and of piece *E* that bears the tool-post. *E* has a truncated V-groove that fits over a corresponding circular projection at *F*. In groove *G*, concentric with *F*, but of larger diameter, are fitted two studs *H* which hold *E* down but still leave it free to turn on its bed. It is rotated by the hand-wheel, shown on the end of whose stem is a pinion that meshes into gear teeth *I* on the outside of *D*.

A piece *A* bolted to the face-plate bears a split mandril that is expanded by means



A HAND-WHEEL TURNING RIG.

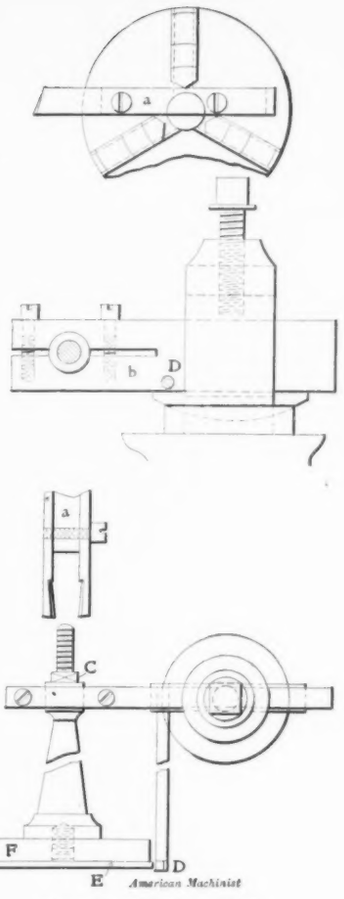
of screw *C*. The hand-wheels are first bored, their hubs (one side) turned and polished and the arms either faced or left rough, according to the design of the wheel. The wheels are put on mandril so that four drivers *M* will touch the four arms. Screw *C* will tighten the wheel on the mandril. The turning rig is then set in place of the compound rest. The cross carriage is brought up to the wheel, taking care to keep the center of *D* under the middle of the spokes. A cut is started from the center of the rim and fed in both ways as far as possible. Two offset tools will finish the rim close to the spokes. A finishing cut is given in the same way.

JOSEPH MENEGUS.

Squaring Small Work.

Editor American Machinist:

The sketch shows a pretty handy method of squaring small pieces in the lathe, as, for instance, *c*, on the little pillar. The fly cutter is made of two pieces of ⅜x⅛ inch steel, with a piece of brass between for distancing and is clamped in the jaw chuck, as shown. *b* is a piece of flat steel bored to fit the neck of the pillar, slotted and with two clamping

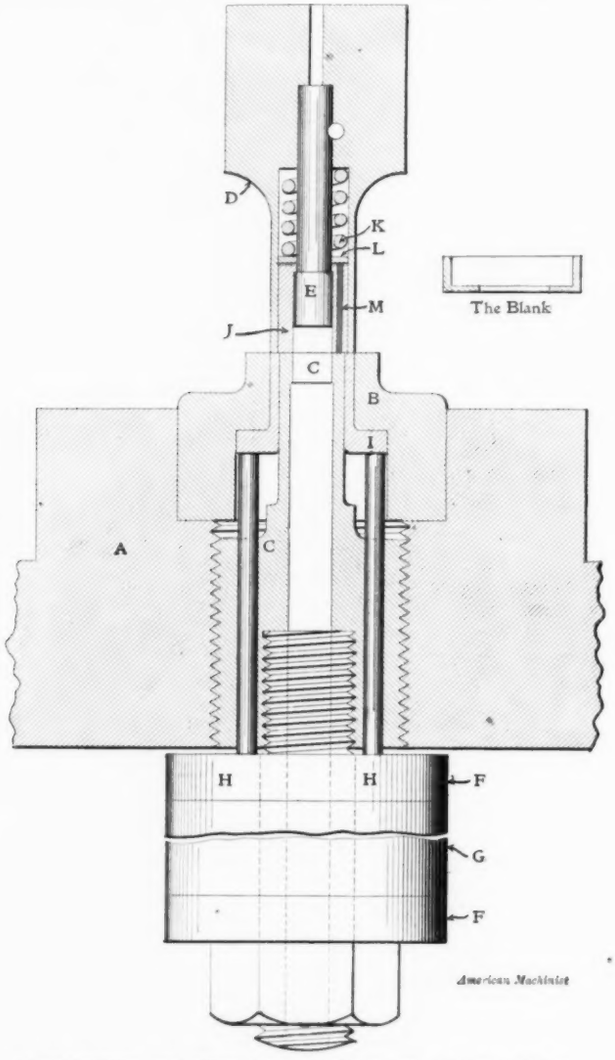


SQUARING SMALL WORK.

screws. *D* is a piece of rod steel filed to a feather edge, *E* a piece of sheet brass with a screw in the center and is screwed in the back or base of the pillar, with a center line struck across it. The setting for cutting the squares is done by the coinciding of the center line on *E* with the feather edge of rod *D*.

J. COOK.

Liverpool, England.



A BLANKING, DRAWING AND PIERCING DIE AND ITS WORK.

A Blanking, Drawing and Piercing Die.

Editor American Machinist:

I send you the drawing of a blanking, drawing and piercing die (here shown full size), made for forming up the blank as shown, which is just a plain round cup, made of .010 inch sheet brass, and must be exact in size, diameter and hight. *A* is the bed plate, into which the blanking die *B* and the piercing die *C* are held. The punch *D* is fitted into a holder which fits into the plunger of the press, which is not shown. The small piercing punch *E* is made first, hardened and ground to size; then the die *C* is made and ground out to fit the punch *E*. It is also ground on the outside to the proper size, which would be the size of the inside of the cup to be produced. The punch *D* is then got out, leaving just enough on the inside to grind, and the outside large, until the size of the blank is ascertained, if this has not already been done. After this is done the

next thing is to finish the die, making the shedders, pins, etc., and grinding them after hardening to fit nicely in their respective places. After the die is all assembled and oiled in all its working parts, it is then set up. The die *B* and punch *D* cut the blank, which is then formed, as the press continues to come down, by the punch *D* drawing the metal over the die *C*, when it is pierced by the punch *E*, completing the cup. *F F* are washers, and *G* is a rubber pad to act as a spring for the push-pins *H*, which work the shedder *I*. *J* is a shedder for shedding the blank from the upper die, which is forced down by the spring *K*. The washer *L* is to push the small shedder pin *M* down after the blank has been shed from the other punch and die and must only come through three or four thousandths of an inch, as it will mark the blank if too long. It is only needed when oil is used on the stock.

M. W. Leech.

Launch of the Wilkes.

A large number of invited guests of the builders—the Gas Engine and Power Company and Chas. E. Seabury & Co.—witnessed the launching of the United States torpedo boat "Wilkes" at Morris Heights, New York city, on Saturday, September 28. The launching was on time and was entirely successful. The leading dimensions of the boat are as follows:

Length on water line, 175 feet.
Width, 17 feet.
Displacement, 165 tons.
Speed, 26½ knots.

The boat is to be driven by twin-screws and two sets of triple-expansion engines of four cylinders each—one of 13, one of 22 and two of 25¼ inches diameter, the stroke being 18 inches. The horse-power is 3,000. The working steam pressure is 250 pounds, the boiler having 127 square feet of grate surface and 7,550 square feet of heating surface. Forced draft is to be used, the pressure of blast being equal to 4½ inches of water. The weight of the machinery is 80 tons and all forgings are of high-grade nickel steel.

More than 3,000 people witnessed the launching, a special train of sixteen cars having been run for the invited guests. The launching was done with engines and boilers in place.

Overworked Railroad Employees.

An unusual thing happened down by the Pere Marquette depot at Portland Sunday morning. The crew of local freight No. 205, west-bound, had been without sleep forty-nine hours and received orders at Grand Ledge to go on the side track at Portland, where through freight No. 56 would overtake and pass them. The crew switched their train on the side track and went to sleep at 2 A. M., expecting to awake as the through freight went by, and resume their journey. But worn-out nature demanded rest, and they slept on. The through freight dashed by on the main track and not one of the crew heard it. It was 6 o'clock when they awoke. The fires were out in the engine and it was broad daylight. Down at the office of the train dispatcher in Grand Rapids the growing column of figures noting the progress of the local freight had suddenly come to a stop; but there was no night operator at Portland and the cause could not be learned until the guilty crew asked for orders after daylight.—"Detroit Free Press."

We object to the use of the word "guilty," as applied to this train crew. Perhaps there was no guilt in connection with the occurrence; but if there was, then it was some official that was guilty of disregarding the fact that men who have had no sleep for forty-nine hours are utterly unfit to have charge of a train. All the previous training and experience of a train crew goes for naught under such circumstances, and the worst of such things is that the accidents caused by such attempts to set aside the law of nature happen not only to the freight trains whose crews are thus outraged, but are liable to happen to any passenger train that may be upon the road at the same time.

An Account of a Strike.

Sixteen molders at the works of the American Foundry Company dropped their tools, kicked the flasks to one side, took a hitch in their suspenders and walked out yesterday.

They struck, not on a matter of wages, but a little personal grievance, and they vowed they would not go back to work until the matter was settled satisfactorily to them.

To-day the molders are all back at their work, the grievance has been settled satisfactorily to both sides, and the iron is running cherry hot again.

The strike of the iron molders is over.

No bloodshed.—Rockford (Ill.) Republic.

A motor fire engine has lately been put into service at Eccles, near Manchester, England. The engine is equipped for first aid and carries five men, four ladders, 300 feet of hose, two stand-pipes and other appliances. It runs 14 miles an hour, ascending any grade in the town. It stood the severe preliminary tests successfully.

In "Science" for September 20 is a communication calling attention to an article in "McClure's Magazine," of which article the writer in "Science" says: "In fact, reading the entire paper, which covers eight pages, there is more dense ignorance and absolute misinformation crowded into it than I have seen anywhere on a similar subject [entomology] within the last decade." It would seem from this that others besides mechanics and engineers find in popular publications technical subjects treated with less regard for accuracy than for literary qualities. We have commented upon some of the pseudo-engineering articles that have appeared in the same pages and that were well calculated to mislead the uninformed.

Mr. Frank S. Gardner, secretary of the New York Board of Trade and Transportation, informs us that the work of obtaining signatures to a petition designed to secure interchangeable mileage tickets for commercial travelers has been completed and that therefore no authorized person is now soliciting money or signatures for the purpose.

Personal.

Joseph H. Washburn has been appointed manager of the Roller Bearing and Equipment Company, of Keene, N. H. Mr. Washburn was connected with the Ball Bearing Company, of Boston, for several years.

Prof. Edwin Haviland, Jr., B.S. (Swarthmore), M.A. (Cornell), has been appointed to the Chair of Civil Engineering in the Thomas S. Clarkson Memorial School of Technology, at Potsdam, N. Y. W. S. Graffam, B.S. (Worcester Polytechnic Institute), has been appointed Superintendent of Shops in the same school.

Obituary.

Elliott Perry Gleason died in Brooklyn, Sept. 26, eighty years old. Mr. Gleason was born in New Hampshire, moved to Boston about 1835 and later to Providence. In 1851 he was making gas burners and later perfected the Argand burner, which brought him a fortune. He was engaged in manufacturing in New York in 1861, and in 1871 he incorporated the Gleason Manufacturing Company. He was also the principal owner of three different companies in Seneca Falls, N. Y., where he was known as the "workingman's friend."

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 36.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Gas engines. Northern Engin'r'g Works, Detroit, Mich.

Wanted—Large horizontal boring mill. Materne Mfg. So., St. Louis.

Light machinery built to order. American Machine Co., Wilmington, Del.

Map or mechanical draftsman. H. A. Horsfall, 136 Liberty st., New York.

Experimental work, light machinery made. S. Messerer, 24 Boudinot st., Newark, N. J.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas, Bridgeport, Ct. Send for index sheet.

Elec. & mech. designing & drawing, also ideas developed. Box 709, Schenectady, N. Y.

F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, Pa., build light machinery.

Selden Packing for Stuffing box, with or

without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

See 12 presses & dies for sheet-metals, S. E. cor. Machinery Hall, Buffalo Exposition. Ferracute Mch. Co., Bridgeton, N. J.

Wanted—A 100-pound power spring hammer of any good make. Send description and price to Thomas B. Jeffery & Co., Kenosha, Wis.

For Sale at Low Price—Two Warner & Swasey's four-spindle valve milling machines in good condition; W. & S. 1901 catalog, page 54. The Kelly & Jones Co., Greensburg, Pa.

Gear and Milling cutters, adjustable reamers and special tools; vertical millers, cutter and surface grinder and shears. Catalog of small tools free. R. M. Clough, Tolland, Conn.

To Exchange—A 5 horse-power horizontal gasoline engine, complete, for a second-hand screw machine, in good order, with a capacity of about 1 inch. Address Winkley Co., Hartford, Conn.

Purchaser for small manufacturing plant; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Madison, Wis.

A prominent typewriter manufacturing company have just opened a department for the manufacture and sale of novelties. Responsible parties having something of this class to turn out will oblige by addressing "Work," care AMERICAN MACHINIST.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wanted—Partner with capital; an ambitious man with mental comprehension and capital can learn of rare opportunity to establish lucrative business of magnitude from moderate start; foundry and machine shop, water driven; this seeks earnest business man with commercial ability and "sand." Address Box 69, AMERICAN MACHINIST.

For Sale or Trade—Machine shop, 40x40; 500 ft. glass light; first-class location here; 1 Putnam lathe, 20 in.; 1 Lodge & Davis drill press, 32 in.; 1 New Haven drill, 16 in.; 1 6 in. iron shear, 1 emery wheel and stand, 1 steam engine, 6 H. P.; upright boiler, Fritze make; 41 ft. 2 3-16 shafting, complete with hangers, and lot of small tools. Don't write unless you are in for business. Martin Hamm, Strasburg, Shelby Co., Ill.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines ac-

Draftsmen Wanted.

We have positions open for capable, experienced Mechanical Draftsmen. Our business is to assist Draftsmen and Engineers (technical men only) to secure positions when unemployed, and to better their positions when employed. Our business was established in 1893.

No registration fee. THE ENGINEERING AGENCY, 1605 Monadnock Block, CHICAGO

FOR SALE.

2" Olsen Bolt Header (second-hand).
1½" National Double Bolt Cutter (second-hand).
4 Spindle Geared Nut Tapper (second-hand).
20' x 12' New Cincinnati Cp'd Rest Lathe (new).

VONNEGUT HARDWARE CO., INDIANAPOLIS, IND.

FOR SALE.

Two 4x16-foot Horizontal Tubular Boilers, 53 and 59 3-inch tubes, in excellent condition, together with about 70 feet of 30-inch iron Stack, with connecting horizontal flue; also one Stack, in three 24-foot lengths, two lengths 40 inches diameter, one length tapering from 48 to 40 inches diameter, ¼-inch iron flanged joints.

JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J.

The Sheffield Engineers, Limited,

are open to take up the **manufacture** or sole English **selling rights** of one or two good Mechanical or Electrical **specialties.**

WELLINGTON WORKS, Rockingham Lane, - Sheffield, England.

FOR SALE.

The Drawings, Patterns and Patents of the Fischer Single and Double Valve Steam Engine, from 20 to 500 H. P. Will consider propositions from thoroughly responsible concerns only.

Address F. F. FISCHER, S. 21st and Mary Sts., Pittsburgh, Pa.

VALUABLE BOOKS.

Mechanical Movements, Powers, Devices and Appliances, By Gardner D. Hiscox. **Price, $3.00**
Horseless Vehicles, Automobiles and Motor Cycles, By Gardner D. Hiscox. **Price, $3.00**
Gas Engine Construction, By Parsell & Weed. **Price, $2.50**
Liquid Air and the Liquefaction of Gases, By Prof. T. O'Conor Sloane. **Price, $2.50**
Gas, Gasoline and Oil Engines, By Gardner D. Hiscox. **Price, $2.50**
Complete Electrical Library (5 volumes), By Prof. T. O'Conor Sloane. **Price, $5.00**
Linear Perspective Self-Taught, By H. T. C. Kraus, C. E. **Price, $2.50**
Inventor's Manual, How to Make a Patent Pay, New, revised and enlarged edition. **Price, $1.00**
Saw Filing and Management of Saws, By Robt. Grimshaw. **Price, $1.00**
Compressed Air and its Applications, (shortly).

FREE A special descriptive circular of any of these books sent on request. Our 96 page catalog of scientific and practical books, sent free to any address in the world on request.

NORMAN W. HENLEY & CO., PUBLISHERS, 15 Beekman St., NEW YORK.

Bicknell's Handy Tools.

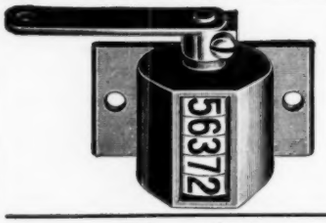
Cutting and Splitting Shears for light and heavy work. Handy Punches, Emery Grinders, Buzz Planers and other tools of latest improved patterns.

THE BICKNELL HARDWARE CO., Box 8005—M. Janesville, Wis.

EXPANDED METAL LOCKERS

CONTINUE TO SATISFY EVERYONE.
SANITARY AND SECURE.
ALWAYS CLEAN AND ATTRACTIVE.
THEY ARE A GOOD INVESTMENT.

MERRITT & CO., 1025 RIDGE AVE., - PHILADELPHIA.



Ratchet & Rotary Counters

for voting machines, nickel in slot machines and automatic machinery generally, to register number of pieces or quantity produced—for any purpose requiring a small, light and accurate instrument.

Exhibit in Transportation Building, Pan-American Exposition.

THE VEEDER MFG. CO., Hartford, Conn.
Makers of Counters, Cyclometers, Odometers, Fine Castings.

Jenkins Brothers' Valves

are manufactured of the best steam metal, and are fully guaranteed. Why experiment with cheap valves? If you want the **BEST** ask your dealer for valves manufactured by Jenkins Brothers. Remember all genuine are stamped with Trade Mark like cut.

JENKINS BROTHERS, New York, Philadelphia, Chicago, Boston
62 Watling St., Queen Victoria St., London, E. C.

TOOL STEEL BALLS

We have the largest and best equipped plant in the world devoted to the manufacture of tool steel balls. The steel used has a uniformity of hardness, toughness and wearing qualities never before attained. Our regular stock consists of balls in sizes from 1/16 to 4 in. in diameter. We grind balls to any of the intermediate sizes. Can also furnish balls in Bessemer steel, brass, bell metal, etc.

THE AUTOMOBILE & CYCLE PARTS CO
CLEVELAND BALL AND PEDAL FACTORY
CLEVELAND, OHIO.

Factories:
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GOLD MEDAL.

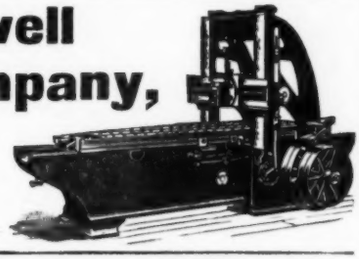
ALL CONTROLLED BY THE

NICHOLSON FILE CO.

Address all Orders and Correspondence to the
Main Office at PROVIDENCE, R. I., U.S.A.

Woodward & Powell Planer Company,

WORCESTER, MASS.



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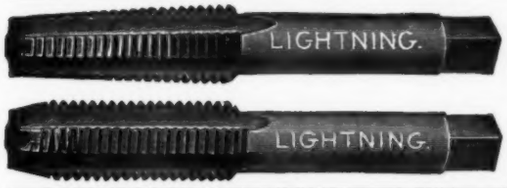
Parke & Lacy Co., San Francisco, Cal.
Robinson & Carey Co., St. Paul, Minn.
Manning, Maxwell & Moore, Chicago, Ill.
Manning, Maxwell & Moore, New York City.



FINEST
Machine Relieved Taps,
ALSO
Dies, Screw Plates, Reamers, Etc.
Send for Catalog.
Wiley & Russell Mfg. Co.,
Greenfield, Mass., U. S. A.
Agents in London, SELIG SONNENTHAL & CO., 85 Queen Victoria Street.

FILES and RASPS.

The leading makes at lowest prices. Ask for our Special File Catalog No. 131—illustrated with half-tone cuts and containing 11 pages of "Hints and Suggestions as to the Proper Method of Using Files." No charge for copies.

HAMMACHER, SCHLEMMER & CO., 209 Bowery, New York, since 1848.

The J. M. Carpenter Tap and Die Co.

PAWTUCKET, R.I., U. S. A.
Manufacturers of Reliable Tools for Cutting SCREW THREADS.

Incorporated 1891

Trade Mark.

Catalog of 118 pages sent free.

1870 Established.

CATCH THE DUST
IN YOUR MILL OR FACTORY BY USING AN
ALLINGTON & MARSHALL
DUST COLLECTING SYSTEM
ALLINGTON & CURTIS MFG. CO.
MONADNOCK BLK. CHICAGO.

ESTABLISHED 1844
DUNBAR BROTHERS
MANUFACTURERS OF
STEEL (OIL TEMPERED) SPRINGS
ALL KINDS OF SMALL SPRINGS
MADE FROM
SHEET STEEL, STEEL & BRASS WIRE.
BRISTOL, CONN. P.O. BOX 416

cepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Position as designer of printing presses, by experienced man. Box 63, AMER. MACH.

Draftsman wants position as designer of special machinery. Box 62, AMER. MACH.

Mechanical draftsman, technical graduate, 6 years' experience, wants position. Box 82, AMERICAN MACHINIST.

Machine shop foreman with first-class references desires position; correspondence solicited. Box 88, AMERICAN MACHINIST.

Experienced mechanical draftsman wants position; electrical machinery preferred. Address K. E. A., Box 81, AMER. MACHINIST.

Evening employment, at home or otherwise, in New York, by Cornell electrical and mechanical engineer. Box 51, AMER. MACH.

Mechanical draftsman, employed with steel company, wishes to change; Pittsburgh preferred. Box 80, AMERICAN MACHINIST.

Thoroughly competent man, 10 years' experience as foreman, desires change; general jobbing and repairs. Box 78, AMER. MACH.

Foreman patternmaker desires a change; 20 years' experience; best of references; reasonable salary. Address, with offer, Box 77, AMERICAN MACHINIST.

Technical graduate, 2 years' experience air-compressor work, desires position with New York engineering or contracting firm. Box 73, AMERICAN MACHINIST.

Competent machinist, with up-to-date experience as draftsman, foreman and superintendent, is open to engagement. Box 83, AMERICAN MACHINIST.

Draftsman as designer of printing presses or special machinery, where originality of ideas and ability will be appreciated; Western States preferred. Box 64, AMER. MACH.

Designer of machine tools and jigs, now holding responsible position, desires, for private reasons, to change; has first-class record; salary $1,500. Box 54, AMER. MACH.

Foreman wants position; first-class toolmaker; 17 years' experience on automatic machinery and tools for sheet metal and jig work; able to improve. Address Box 68, AMERICAN MACHINIST.

Stevens graduate, 5 years' experience, principally in high-pressure compressed air and steam, would like position as engineer or superintendent; will go anywhere. Box 75, AMERICAN MACHINIST.

Mechanical engineer, technical graduate, having held position of chief draftsman and assistant superintendent of several concerns, wishes position after October 10. Box 76, AMERICAN MACHINIST.

Position by designer and draftsman; 6 years' shop, 5 years' drafting-office, on screw, textile, special automatic machinery, special and machine tools; M. I. T.; American; age 32. Box 72, AMERICAN MACHINIST.

Mechanical draftsman, rapid, earnest worker, technical graduate, expert in machine design, desires special work in New York city while temporarily disengaged; exceptional references. "M. E.," Box 79, A. M.

Mechanical engineer, 29, experienced in design, construction and installation of engines and machinery, steam and gas engines, air compressors and motors, automobiles; can take charge of shop, office or drafting room. Box 74, AMERICAN MACHINIST.

Mechanical engineer, technical education, 10 years' practical experience in designing and constructing new machinery for entire plants, just completing large plant, open for engagement in November; exceptional references. Box 66, AMERICAN MACHINIST.

A machinery salesman, who is a practical mechanic and has been works superintendent, desires to make a change; during the last 9 years has sold and directed the sale of machine tools in Europe and America and is fully competent to fill position as sales manager. "Aggressive American," Box 71, A. M.

An energetic mechanic of inventive and executive ability desires position as superintendent or shop manager; thoroughly up on modern methods of precision work, duplicate manufacture, automatic machinery, etc.; has held responsible positions in Europe and America for past 10 years. Address H. A. L., care F. C. Osborn Co., 184 Brush st., Detroit, Mich.

Help Wanted.

Wanted—A first-class toolmaker, by The Lane & Bodley Co., Cincinnati, O.

Wanted—A first-class draftsman familiar with paper machinery. Box 41, AM. MACH.

Molders; 35c. per hour; engine and general job work; no bench men. Denver Engineering Works, Denver, Colo.

Wanted—A1 molders; open shop; must be first-class men; such men will be paid highest wages. Box 65, AMERICAN MACHINIST.

First-class brass molder wanted as working foreman in a small brass shop near New York; references required. Address Box 43, AMERICAN MACHINIST.

Wanted—A young man with some knowledge of drafting; state experience and wages expected. Address "Worcester County," care AMERICAN MACHINIST.

Wanted—5 or 6 good toolmakers, experienced in fine tools, such as typewriter, gun and sewing-machine work. Address Box 70, AMERICAN MACHINIST.

Good patternmakers, both wood and metal, desiring steady employment, will find it to their advantage to apply to the General Electric Co., Schenectady, N. Y.

Wanted—First-class machinist for 10 ft. boring mill, also toolmakers and lathe hands; good wages; steady work. Apply Michigan Brass & Iron Works, Detroit, Mich.

We invite applications from machinists and molders; give references, experience and wages expected; work on air compressors. Franklin Air Compressor Co., Franklin, Pa.

Wanted—Mechanical draftsman and designer for special lathes, conveyors and other special machinery; state age, experience and and salary expected. Box 87, AMER. MACH.

Wanted—Experienced mechanical draftsman, energetic and systematic; location, Trenton, N. J.; give full particulars and salary expected. Address Box 85, AMER. MACH.

Wanted—A good mechanical draftsman; one competent to make correct drawing, having technical and practical experience; would be willing to pay for the right man. Box 46, AMERICAN MACHINIST.

We will pay $3.50 per day to first-class lathe, planer and vise hands; work in open shop; $3 a day being paid on regular pay days and balance to be paid at the end of four months' service. Address R., care A. M.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Machinists; a few good vise men in a small town in Ohio to work on small, close work; good wages and steady work to competent and reliable men; in answering, state whether union or non-union. Address Box 84, AMERICAN MACHINIST.

Wanted—A first-class screw machine hand familiar with hollow hexagon turret or flat turret machines, also lathe and planer hands and large boys and young men that desire to learn to operate lathes and planers. Box 67, AMERICAN MACHINIST.

Wanted—Two all-round machinists for iron works repair shop; non-union men from Maryland or Virginia preferred, only men wanted are those willing to work. Address, giving age, experience and wages expected, "Furnace," Care AMERICAN MACHINIST.

Wanted—A competent man to run, and later take charge of, a turret lathe department in San Francisco; must be familiar with either the hollow hexagon or flat turret lathes; a good position for the right man. Address Box 86, AMERICAN MACHINIST.

Wanted—First-class foreman on small tools; average about 16 in. lathes, shapers, milling machine, turret lathes, etc.; an excellent opportunity for the right sort of a man, who is capable, ambitious and a hard worker. Address Box "X," AMER. MACH.

Wanted—An expert and experienced designer of jigs, fixtures and small tools generally; familiar with drafting-room practice, and competent to act as a drafting-room foreman on such work. Write age, experience and salary expected to S. T. B., care AM. MACH.

Wanted—A first-class shop foreman, to take charge of machine work on hoisting machinery; must understand drawings, handling men, and have up-to-date ideas of forcing production; a good position for an energetic, aggressive man; state age, experience and salary desired. Box 40, AMER. MACHINIST.

Wanted—First-class mechanical draftsmen to take positions in new Westinghouse Electric Works, at Manchester, England; name references and state age, experience in detail and salary wanted; men having experience in both Great Britain and America preferred. Address British Westinghouse Electric & Mfg. Co., Ltd., Pittsburg, Pa.

Brown & Sharpe Mfg. Co.,

PROVIDENCE, R.I., U.S.A.

"Brown & Sharpe" Spring Calipers and Dividers.

Something New

Firm Joint Inside and Outside Calipers.

Three Things Worth Noting

DESIGN

Pleasing to the eye,
Convenient to use,
Light in appearance, yet substantial.

WORKMANSHIP

Of the best, as shown in the carefully finished product.

QUALITY

Shown in the way they meet the most exacting requirements, as well as in the materials used in their construction.

A Distinctive Feature

The New Spring Nut-Chuck

A Spring hardened jaws, sliding freely on the *hardened screw.*

Your nearest hardware dealer will be glad to show you these goods or we will mail you a booklet upon application.